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ABSTRACT

Chapter 1 of this highly detailed book examines the flow of foreigners who receive their doctorate in the US by area of origin and destination, wealth of origin and destination area, and field of specialization. The backgrounds and characteristics of US citizens who go abroad for employment are compared with those of citizens remaining in the US. Chapter 2 reviews the history of PhD-producing schools and its effect on geographic distributions of population. The problem of a state-by-state versus a national point of view with respect to education and employment of high level personnel is described in Chapter 3. Chapter 4 seeks to explain the dynamics of migration by analysis of a large number of state characteristics related to migration. Chapter 5 explores follow-up data collected and maintained by the National Science Foundation for its National Register of Scientific and Technical Personnel. Geographic migration, employment, and principal work activities actually experienced are compared with expectations at the time of PhD graduation. Chapter 6 lists some unanswered questions regarding the mobility of high-level personnel. Figures and tables illustrate the discussion. (JS)

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CAREER PATTERNS REPORT NUMBER THREE

PREPARED FOR THE NATIONAL INSTITUTES OF HEALTH UNDER CONTRACT PH 43-64-44

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with Associated Economic and Educational Characteristics of States

NATIONAL ACADEMY OF SCIENCES

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Mobility of PhD's

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Prepared in the
RESEARCH DIVISION
of the
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HIGHLIGHTS

- In the post-World War II years, the United States has attracted great numbers of foreign students at all levels, and many have stayed, constituting what has been termed "the brain drain." At the doctorate level, about 19 percent of U.S. PhD's are foreign-born. Almost 15 percent are foreign citizens, and from 1965 to 1968, 43 percent of these planned to remain in the United States. This percentage varies widely by field and by country of origin: It is very high for engineering and physical sciences, and low for agriculture.
- International movement varies by economic status of the country of origin. The general movement is upward on the economic scale, but movement in *both* directions is, in general, greater for the citizens of the more prosperous countries.
- Doctorate production in the United States has changed its geographic distribution progressively over the past 50 years. Originally concentrated heavily in a few northeastern states, it has tended to extend more equitably across the country as it has grown in total volume. It is still more concentrated than baccalaureate production, which in turn is also more concentrated than the general population; however, even the latter follows the same pattern, with concentrations on the coasts and around the Great Lakes.
- States vary enormously in their standing (on a per capita basis) as "producers" (or origins) and as "consumers" (destinations) of PhD's, although most of the states that are high producers are also high consumers because most PhD's are employed in universities. The reverse is not true: Some states that employ many (e.g., Delaware) are relatively low as origins of PhD's.
- To study the movements of the PhD's at various career stages, a quantitative metric of geographic movement was devised, and movements at each stage were expressed in terms of this metric—movement in 10-mile units on a north–south and an east–west axis.
- Movements from one's home state in eight directions—north, northeast, east, southeast, south, southwest, west, and northwest, for each state—are

pictured graphically by means of a computer program based on the geographic grid. Movements at each of several career stages are shown on a reduced scale, for each of the states.

- State characteristics that might be associated with migration were studied, and three "per capita" indices were derived for each state: an economic prosperity index, an index of higher educational development, and an index of elementary–secondary school strength. These indices are positively but not highly correlated; the highest is between economic prosperity and the elementary–secondary school index. This correlation is largely accounted for on a geographic basis; regional covariation is particularly apparent on this pair.
- State-to-state variations in these indices are shown in tabular form and graphically by means of maps and state profiles. On these state profiles, the west is outstanding in the relative strength of its elementary–secondary school systems, the northeast in economic strength, and several eastern states (but not all) in higher education development.
- State standings on pairs of these indices were also shown graphically by means of "pseudomaps" that relate each index to each other index. The relationship of these indices to migration was given in tables showing the movement of the eventual PhD's at each career stage from high school to post-PhD job, in geographic terms of the three state indices. An illustration of the analyses possible with these tools was provided by correlations of the indices of origin and of destination, and by correlation of ratios of the indices to percentages of gain or loss at a given career transition.
- Migration tends to distribute PhD-trained people from the more affluent (educationally and economically) portions of the country to the poorer sections. However, this was shown to be only a partial process, with a striking reproduction of the sectional sorting of the states of origin on a "regression map" of the states of destination of the PhD's.
- Many questions remain to be answered, including quality differences in the various migration streams, field variations, and whether PhD migration is primarily a creator or consequence of economic prosperity.

FOREWORD

From colonial times to the present, Americans have moved across oceans and a continent. Although the geographic frontier closed 80 years ago, westward movement of the population has continued. But the movement is not only westward: Northerners move South, southerners move North, and westerners move East, in ever-increasing numbers and to ever-increasing distances. Concomitantly, social, economic, disciplinary, and occupational mobility characterize all but the very poorest of our society.

These various kinds of mobility are highly important for the country as a whole and for the academic community in particular. Exchange of ideas, of skills and of styles of life enrich the opportunities for all by introducing variety and by preventing "the crust of custom" from becoming too hard and heavy. Paradoxically, they also tend to homogenize our culture—a tendency re-enforced by continental television, national weeklies, and coast-to-coast dialing, all of which combine to convert the disparate cultures of this nation into a single society.

The present report is concerned specifically with the mobility of holders of the doctorate. Immigration and internal migration are both considered, as are the factors that govern mobility among disciplines and occupations. Although the mass immigrations of the nineteenth century have now been reduced to a trickle, inflow of scholars and scientists from other countries continues. A large fraction of outstanding scientists in this country today were born elsewhere. The internal migration of students who eventually earn doctorates is numerically greater by an order of magnitude than is the external migration. As they move from state to state at various career stages, they encounter differing conditions of economic level and educational development. In turn, as they graduate and enter gainful employment, their contributions affect these same parameters of economy and education. The internal flow of Ph.D.'s significantly reduces the differences among the states, particularly with respect to higher education.

We are indebted to the National Institutes of Health for the support of this study and for that of two earlier reports on the career patterns of PhD's: *Profiles of PhD's in the Sciences* and *Careers of PhD's—Academic vs. Non-*

academic. Dr. Lindsey R. Harmon has served as the staff officer for this series of studies and is the author of its reports. The work was performed in the Office of Scientific Personnel with the advice of the OSP Advisory Committee. Dr. William C. Kelly provided general administrative supervision. It is hoped that the results of the present study may be useful to all concerned with education and employment at the doctoral level.

PHILIP HANDLER
President
National Academy of Sciences

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This study was made possible by support from the Resources Analysis Branch, National Institutes of Health. Their support was not only financial: Dr. Herbert H. Rosenberg and Dr. Allen O. Gamble also contributed many important suggestions from the original conception of the series of Career Patterns studies to the writing of the present report. Valuable suggestions were also made by Mr. Thomas J. Mills and Dr. Milton Levine of the National Science Foundation, who, by making available the data of the National Register of Scientific and Technical Personnel, obviated the need for a special follow-up questionnaire to recent graduates.

To Dr. W. C. Kelly go my thanks for administrative leadership throughout this study. My thanks for staff assistance in the present study go particularly to Dr. Joan G. Creager, now on the faculty of Northern Virginia Community College. Her imagination, effort, and insight were largely responsible for assembling the data on state characteristics and for planning the computer operations for developing the data throughout. For day-to-day meticulous, cheerful, and concientious execution of computer programs, typing, checking, and over-all keeping of order in a mass of detail my thanks go to Mrs. Margaret Louise Hayes. To Mr. Herbert Soldz of the Data Processing Section and to the programmers, particularly Mrs. Ingrid Meier and Mr. Donald Wharton, go my gratitude for massive data processing support; although extensive, the data that appear in this book represent only "the tip of the iceberg."

I owe a particular debt of gratitude to Mr. Leonard Goodwin of the Brookings Institution, who helped immeasurably in the analysis of the state data. Mrs. Doris Rogowski and Mrs. Marilyn Brus deserve recognition for meticulous reading of the manuscript. To Clarebeth Maguire go my thanks for help in the graphic portrayal of the data and for seeing the report through the many production stages. To the reviewers of the final report, Drs. John G. Darley and Conrad F. Taeuber, I am indebted for many valuable suggestions that led to clarifications of concepts and syntax.

Finally, a debt impossible to acknowledge individually is owed to the many thousands of persons whose career data, carefully recorded on the re-

port forms of the Survey of Earned Doctorates, provided the very substance of this report. All these have helped; yet, any insufficiencies or inaccuracies of design or of execution are my responsibility.

LINDSEY R. HARMON
Director of Research
Office of Scientific Personnel

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INTRODUCTION

The growth, transmission, and dissemination of a culture may be effected through books, periodicals, radio, and TV; people, however, are the prime means. Changes that occur through migration, which mixes one culture with another, are a familiar phenomenon throughout history. Today, with migration occurring at an ever-increasing rate and the rapid transmission of all sorts of information, the rate of cultural change has become extreme. Of all changes, those that advance technological and economic processes are perhaps the most sought-after and have been the concern of governing bodies and scholars the world over. Thus, people with the highest level of training are potentially the most effective change agents—particularly in a highly developed economy with ample capital to introduce new technology and with a system of higher education dependent for its quality on an ample supply of teachers and researchers. It is for these reasons that the mobility of PhD's is of particular interest. Countries or areas of countries that experience a loss of their most highly-trained people speak of a brain drain and frequently have been concerned with measures to diminish such a drain. The United States, the principal destination of those "drained" from other countries, is itself the greatest producer of PhD's, both those who remain within the country and those who go abroad. This book is concerned with both of these groups, and with problems not only of international migration, but of the internal brain drain that moves people trained to the PhD level from the area in which they receive their education to the area in which their talents and skills are gainfully employed.

The first chapter of this book is concerned with the migration into the United States of those people from foreign areas who take their doctorates in the United States and thereafter remain, return to their home countries, or go to some third country. It examines this flow by area of origin and destination, by wealth of country of origin and destination, and by field of specialization. United States citizens who go abroad also are examined as to the activity they expect to engage in while abroad and their backgrounds and characteristics as compared with the other United States citizens who remain in the United States for employment.

Chapter II reviews briefly the historical development of PhD-producing schools and its affects on geographic distributions. The changing proportions of total PhD production in the various geographic regions over the past 40 years is shown in both tabular and graphic form, and regional changes in "retention rates" from BA to PhD are given, showing that they are tending toward equality, but have not yet reached that stage. Present geographic distribution of population and of PhD-producing institutions is described, as is the present disparity between state of PhD and state of post-PhD employment. A computer-produced map is shown on which the doctorate-granting institutions are located. State profiles are presented showing the number of eventual PhD's per million population at the high school, undergraduate, graduate school, and employment stages. State centers of population are given on both a regular and a computer-produced map of the United States.

The problem of a state-by-state vs. a national point of view with respect to the education and employment of high-level personnel is described in Chapter III. The development of techniques for dealing quantitatively with internal migration in the United States is described, and computer-produced graphic diagrams are given to show distance and direction of migration of PhD's from each state. A state-to-state table of migration at each career stage is given in Appendix D. The significance of these migration streams is chiefly in their consequences for the economic and educational health of the country. It is a matter of historical record, also, that there is a correlation between economic prosperity and the development of graduate education.

Chapter IV seeks to throw light on the dynamics of migration by analysis of a large number of state characteristics conceivably related to migration: A set of three composite indices descriptive of each state's economic prosperity, elementary–secondary school strength, and higher education development are derived. The numeric values of these indices are given for each state, and maps and state profiles graphically present these indices. The characteristics of the states of destination of those who leave their states of PhD following graduation is examined, particularly from the standpoint of economic prosperity and higher education. It is shown that there is a surprising similarity in the economic–educational indices of the *destinations* of those who move from the several states in each geographic area. A "pseudomap" of the economic prosperity and higher education indices of the destinations of those who move from each state is shown to illustrate this phenomenon. Further detail, including the interactions of these indices, is given in Appendix H on a state-by-state basis.

Chapter V explores the data found in a follow-up of several PhD graduation cohorts from the time of graduation to as long as 5 years later by use of the National Register of Scientific and Technical Personnel, which is maintained by the National Science Foundation. Geographic migration, employer categories, and principal work activities actually experienced are compared with expectations at the time of PhD graduation. Field-switching from doctorate specialization to on-the-job experience several years later is described, with particular attention to the bioscience fields.

Chapter VI lists some questions still unanswered with respect to the mobility of high-level personnel.

CHAPTER I INTERNATIONAL MIGRATION

The many reports on the international flow of people with high levels of training—the brain-drain question—have focussed on various occupational groups and various countries of origin; most consider only or primarily those who come to the United States, with less emphasis on United States citizens going abroad. There are a great many issues involved in this question, and only a limited number of them can be dealt with in a study of PhD's. However, those issues that do impinge on PhD output and utilization need to be clearly understood.

One issue is *brains*. Implicit in most of the studies is some assumption about the people involved representing a highly important segment of the brains of the countries involved. Some writers have been careful to note the difference between those who have had advanced training before coming to the United States and those who have attained their education here. Bayer,[1] for example, has used the terms "trained brain drain (or gain)" and "untrained brain drain (or gain)" to maintain this distinction. The usual assumption with PhD's is that they represent the very best brains in the country. This is undoubtedly true in large measure, if one is speaking of "trained brains." But investigation of the initial level of ability of PhD's—their ability as measured by tests taken at the high school level[2]—shows that they represent only a minor fraction of the people at the highest level of ability. In the United States population, if one considers only those in the range that Terman termed "genius" level, perhaps one in ten now age 30 attains the doctorate. The other nine terminate their training at lower levels. At the ability level of the typical PhD, as measured during high school, perhaps 3 percent attain the doctorate. These figures for the United States undoubtedly represent upper bound figures for other countries that have a much smaller rate of doctorate attainment. The vast majority of people with brains are not

[1] Alan E. Bayer, "The Effect of International Interchange of High-Level Manpower on the United States," *Social Forces* 46, No. 4 (June, 1968).
[2] L. R. Harmon, "High School Backgrounds of Science Doctorates," *Science*, 133, No. 3454 (March 10, 1961). (The percentages cited are inflated from the 1958 data cited, to account for the great increase in PhD output from 1958 to 1968.)

included in the figures of this report. But the report is comprehensive for those who do attain the doctorate in the United States, and who thus do have this high level of "brain training."

The focus on educated brains raises the issue of the cost of education. Where does the money come from to support the schools, colleges, universities, in which these people get their education? What is the economic effect when a person migrates from the country that provided the education to another one where the training is utilized? This is by no means a one-sided question. It is important, also, to look at it from the standpoint of the opportunities a country (or a state in the United States) provides, or should provide, for its own citizens. It can be argued that the state has a responsibility to its own citizens to provide them the best educational opportunities possible, regardless of where those citizens go after completing their education. The economic and technological opportunity for utilization of these developed skills, which is one of the issues involved in the brain-drain question, is related but separable. Although this report is concerned with economic questions, it will not attempt to assess the costs of education, or to define the sources of support for higher education or graduate schools. When appropriate, however, it will make reference to these issues as data are presented on origins, destinations, and utilization.

FOREIGN STUDENTS IN U.S. UNIVERSITIES

To provide a somewhat broader context for examination of the data on doctorate recipients, it may be well to take a look at the whole spectrum of foreign students coming to the United States for higher education. At the present time approximately 100,000 students from abroad are studying in U.S. institutions of higher education, at the undergraduate, professional, and graduate levels. Data on these students is supplied annually by the Institute of International Education.[3] A condensed version of these data is provided in Table 1, which shows the number of students at each level from each of several areas of the world. Canada is the only nation shown separately in Table 1; this is because it supplies such a large proportion (almost 12 percent) of the whole foreign student body. Latin America sends 19.5 percent of the students, Europe 13.5 percent, Africa 6.5 percent, and Western Asia 20.5 percent. Western Asia includes all countries from the eastern end of the Mediterranean to East Pakistan, and is dominated in these figures by India. The rest of the Asian mainland, plus Japan, Okinawa, Taiwan, and North Borneo, constitutes East Asia, and combined sends 23.8 percent of the students. The remaining 4.5 percent come from Australasia, which includes, in addition to Australia, all the other Pacific Islands.

Most of these incoming students (52.1 percent) are at the undergraduate level. Candidates for the master's degree comprise 21.2 percent, and PhD candidates 15.8 percent. All other students, including those with unspecified objectives and those seeking professional degrees, comprise 10.8 percent. These proportions are not constant for all the world areas, however, as

[3] *Open Doors 1968*, Institute of International Education, New York, New York, was used for the analyses in this report. The general trend of the data are relatively stable from year to year.

TABLE 1

Foreign Students in the United States 1967–1968, by Educational Level and World Area of Origin

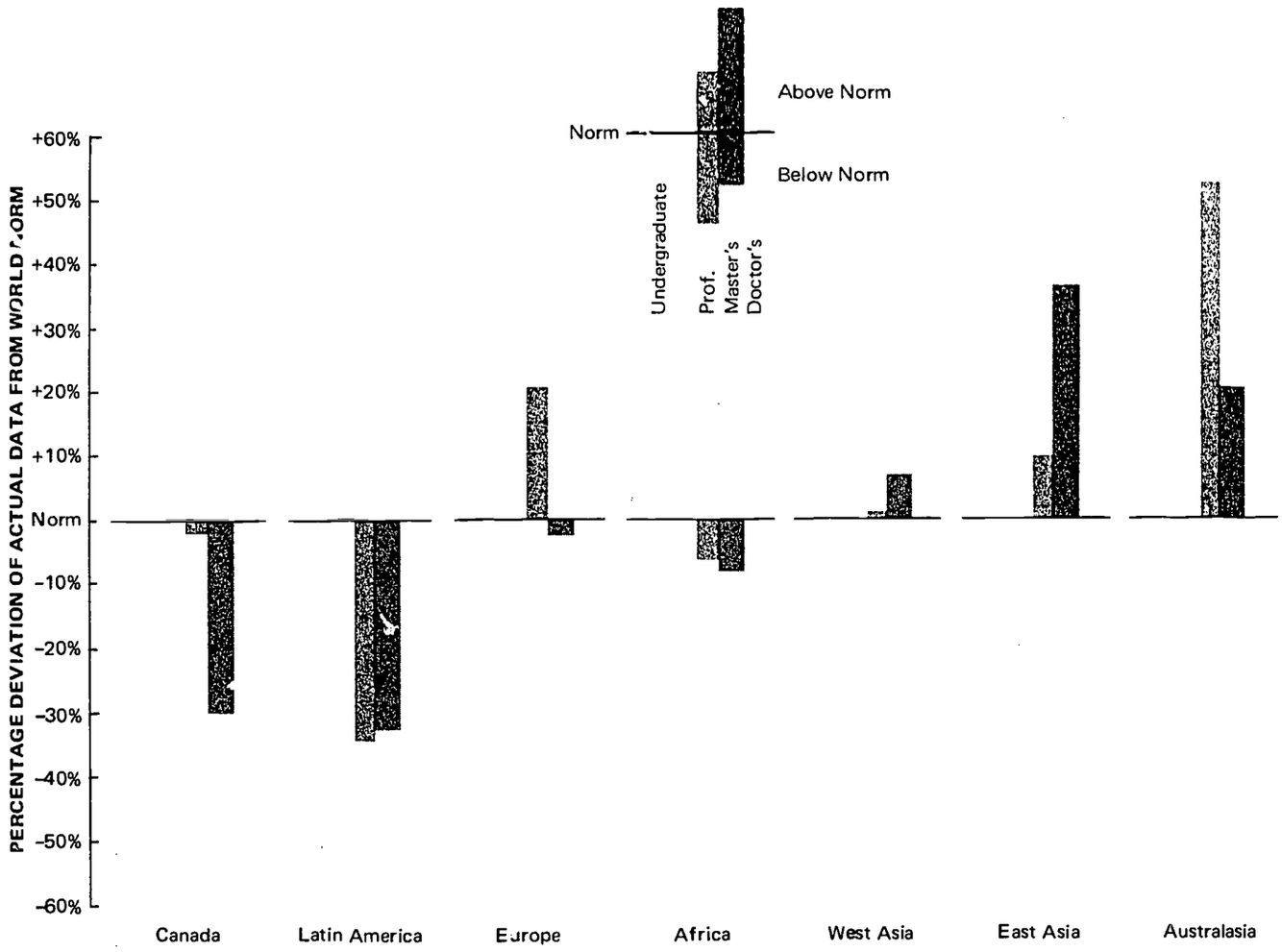
Area		Undergraduate	Graduate Level			Total
			Professional and Unspecified	MA Candidates	PhD Candidates	
Canada	N	6,962	1,251	1,743	1,815	11,771
Horizontal	%	59.1	10.6	14.8	15.4	100.0
Vertical	%	13.3	11.5	8.2	11.4	11.7
Latin America	N	14,174	1,395	2,809	1,231	19,609
Horizontal	%	72.3	7.1	14.3	6.3	100.0
Vertical	%	27.1	12.8	13.2	7.8	19.5
Europe	N	6,602	1,761	2,794	2,377	13,534
Horizontal	%	48.8	13.0	20.6	17.6	100.0
Vertical	%	12.6	16.2	13.1	15.0	13.5
Africa	N	3,614	665	1,281	987	6,548
Horizontal	%	55.2	10.2	19.6	15.1	100.0
Vertical	%	6.9	6.1	6.0	6.2	6.5
West Asia[a]	N	9,353	2,228	4,634	4,291	20,506
Horizontal	%	45.6	10.9	22.6	20.9	100.0
Vertical	%	17.9	20.5	21.8	27.0	20.5
East Asia[b]	N	9,844	2,827	6,876	4,317	23,864
Horizontal	%	41.3	11.9	28.8	18.1	100.0
Vertical	%	18.8	26.0	32.3	27.2	23.8
Australasia[c]	N	1,775	744	1,153	849	4,521
Horizontal	%	39.3	16.5	25.5	18.8	100.0
Vertical	%	3.4	6.8	5.4	5.4	4.5
Total	N	**52,324**	**10,872**	**21,290**	**15,867**	**100,353**
Horizontal	%	**52.1**	**10.8**	**21.2**	**15.8**	**100.0**
Vertical	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[a]West Asia includes all countries east of the Mediterranean as far as East Pakistan.
[b]East Asia includes the rest of the Asian mainland plus Ceylon, Japan, Okinawa, the Ryukyus, and North Borneo.
[c]Australasia includes Australia and all the remaining Pacific islands.

shown by the percentage figures in Table 1. For each country and each world area there are several and varying factors that influence the number of students who come to the United States. To provide a generalized framework for comparing world regions with regard to the over-all effect of these "pushes and pulls," we have taken as a norm or frame of reference the percentage totals of all foreign students from all world regions for the various levels given above. We have then considered each region in terms of the extent to which it deviates from this norm, to derive the graph shown in Figure 1. The western hemisphere supplies relatively more undergraduates, Europe and Africa are close to the norm, while the Asian countries send relatively more at the graduate levels and fewer undergraduates. Many factors, such as distance, the nature of the home country's educational system, and

FIGURE 1

Variations in relative student population at four educational levels, by foreign source. (Data from Table 2.)



the culture, including particularly language, are no doubt important in determining these proportions. Table 2 gives the data on which Figure 1 is based, including the actual numbers from each area at each level, the numbers that would be expected if all areas were equal to the world norm, and the difference between the actual and "expected" figures, in raw numbers and in percentage. These percentages (difference/expected values) are plotted in Figure 1.

POSTDOCTORAL STUDENTS

Postdoctoral students are a special case among foreign citizens studying in the United States. "Postdoctoral" is a term used to include people whose appointments may be under any of several rubrics–postdoctoral fellows, postdoctoral trainees, and research associates are the most common terms. They may enter such training immediately after the PhD (or equivalent foreign

TABLE 2

Numbers of Students[a] from Each World Area at Each Educational Level vs. Numbers That Would Be Expected If All Areas Were Equal in Student Inputs and Percentage Discrepancies

Country or Area	Level of Higher Education Students				
	Undergraduate	Professional & Unspecified	Master's Candidates	Doctoral Candidates	Total
Canada					
Actual	6,962	1,251	1,743	1,815	11,771
Expected	6,137	1,275	2,498	1,861	11,771
Difference	+825	−24	−755	−46	0
% Difference	+13.4	−1.9	−30.2	−2.5	0
Latin America					
Actual	14,174	1,395	2,809	1,231	19,609
Expected	10,224	2,124	4,160	3,101	19,609
Difference	+3,950	−729	−1,351	−1,870	0
% Difference	+38.6	−34.3	−32.5	−60.3	0
Europe					
Actual	6,602	1,761	2,794	2,377	13,534
Expected	7,057	1,466	2,871	2,140	13,534
Difference	−455	+295	−77	+237	0
% Difference	−6.4	+20.1	−2.7	+11.1	0
Africa					
Actual	3,614	666	1,281	987	6,548
Expected	3,414	710	1,389	1,035	6,548
Difference	+200	−44	−108	−48	0
% Difference	+5.9	−6.2	−7.8	−4.6	0
West Asia					
Actual	9,353	2,228	4,634	4,291	20,506
Expected	10,692	2,222	4,350	3,242	20,506
Difference	−1,339	+6	+284	+1,049	0
% Difference	−12.5	+0.3	+6.5	+32.4	0
East Asia					
Actual	9,844	2,827	6,876	4,317	23,864
Expected	12,443	2,585	5,063	3,773	23,864
Difference	−2,599	+242	+1,813	+544	0
% Difference	−20.9	+9.4	+35.8	+14.4	0
Australasia					
Actual	1,775	744	1,153	849	4,521
Expected	2,357	490	959	715	4,521
Difference	−582	+254	+194	+134	0
% Difference	−24.7	+51.8	+20.2	+18.7	0
Total of all areas	**52,324**	**10,872**	**21,290**	**15,867**	**100,353**

[a]The actual number of foreign students coming to the United States from each of the specified areas in the academic year 1967–68 is shown as the top number in each cell. The expected numbers are calculated on the basis of an equal percentage distribution across the four levels for all world areas. For example, the ratio of total undergraduates to total students (52,324/100,353 = 0.5214 or 52.14%) was applied to the 11,771 total students from Canada, yielding an expected total of 6,137 undergraduates. As shown in the upper left corner, the difference, +825 from the actual total of 6,962, is a percentage difference of +13.4 above the expected value. The same undergraduate ratio of 0.5214 was applied to each country; then, comparable ratios were developed and used in the same way for the other three types of students.

TABLE 3

Planned Post-Training Destinations of Postdoctoral Appointees of Foreign Citizenship, by Source of PhD and World Region of Citizenship

Region of Citizenship	Grand Total		Unknown			Planned Post-training Destination of Those with Definite Plans											
						Total Known			Remain in U.S.			Return Home Region			Go to Other Region		
	N	V%[a]	N	H%[b]	V%[a]	N	H%[b]	V%[a]	N	H%[c]	V%[a]	N	H%[c]	V%[a]	N	H%[c]	V%[a]
Foreign postdoctorals with U.S. doctorates																	
Canada	58	8.6	11	19.0	6.6	47	81.0	9.3	30	63.8	10.0	16	34.0	8.6	1	2.1	5.3
Latin America	17	2.5	3	17.6	1.8	14	82.4	2.8	9	64.3	3.0	5	35.7	2.7	–	–	–
Europe	71	10.5	14	19.7	8.4	57	80.3	11.2	42	73.7	14.0	12	21.0	6.4	3	5.3	15.8
Africa	22	3.3	3	13.6	1.8	19	86.4	3.7	8	42.1	2.7	10	52.6	5.3	1	5.3	5.3
West Asia	229	34.0	49	21.4	29.3	180	78.6	35.5	74	41.1	24.6	100	55.6	53.5	6	3.3	31.6
East Asia	251	37.2	84	33.5	50.3	167	66.5	32.9	129	77.2	42.9	31	18.6	16.6	7	4.2	36.8
Australasia	26	3.9	3	11.5	1.8	23	88.5	4.5	9	39.1	3.0	13	56.5	7.0	1	4.3	5.3
Total	674	100.0	167	24.8	100.0	507	75.2	99.9	301	59.4	100.2	187	36.9	100.1	19	3.7	100.1
Foreign postdoctorals with foreign doctorates																	
Canada	94	3.5	17	18.1	5.3	77	81.9	3.3	15	19.5	5.4	58	75.3	2.9	4	5.2	4.4
Latin America	42	1.6	10	23.8	3.1	32	76.2	1.4	7	21.9	2.5	24	75.0	1.2	1	3.1	1.1
Europe	1,449	53.8	185	12.8	57.3	1,264	87.2	53.4	152	12.0	54.3	1,051	83.1	52.6	61	4.8	67.8
Africa	28	1.0	5	17.9	1.5	23	82.1	1.0	1	4.3	0.4	18	78.3	0.9	4	17.4	4.4
West Asia	506	18.8	50	9.9	15.5	456	90.1	19.2	48	10.5	17.1	399	87.5	20.0	9	2.0	10.0
East Asia	434	16.1	40	9.2	12.4	394	90.8	16.6	45	11.4	16.1	343	87.1	17.2	6	1.5	6.7
Australasia	13[illegible]	5.2	16	11.5	5.0	123	88.5	5.2	12	9.8	4.3	106	86.2	5.3	5	4.1	5.6
Total	2,692	100.0	323	12.0	100.1	2,369	88.0	100.1	280	11.8	100.1	1,999	84.4	100.1	90	3.8	100.0
Total, all sources of doctorate																	
Canada	152	4.5	28	18.4	5.7	124	81.6	4.3	45	36.3	7.7	74	59.7	3.4	5	4.0	4.6
Latin America	59	1.8	13	22.0	2.7	46	78.0	1.6	16	34.8	2.8	29	63.0	1.3	1	2.2	0.9
Europe	1,520	45.2	199	13.1	40.6	1,321	86.9	45.9	194	14.7	33.4	1,063	80.5	48.6	64	4.8	58.7
Africa	50	1.5	8	16.0	1.6	42	84.0	1.5	9	21.4	1.5	28	66.7	1.3	5	11.9	4.6
West Asia	735	21.8	99	13.5	20.2	636	86.5	22.1	122	19.2	21.0	499	78.5	22.8	15	2.4	13.8
East Asia	685	20.4	124	18.1	25.3	561	81.9	19.5	174	31.0	29.9	374	66.7	17.1	13	2.3	11.9
Australasia	165	4.9	19	11.5	3.9	146	88.5	5.1	21	14.4	3.6	119	81.5	5.4	6	4.1	5.5
Total	3,366	100.1	490	14.6	100.0	2,876	85.4	100.0	581	20.2	99.9	2,186	76.0	99.9	109	3.8	100.0

[a]Percent by region (vertical).
[b]As a percent of grand total (horizontal).
[c]As a percent of total known.

training) or after several years of professional experience. Data about these students comes from a survey conducted by the Office of Scientific Personnel in the fall of 1967.[4] The origins of these students are quite different from those at the predoctoral levels (46 percent come from Europe, for example). Eighty-two percent come to the United States with doctorates earned abroad, and their fields of study are concentrated heavily in the natural sciences (61 percent in mathematics, physical sciences, and engineering; 35 percent in the biomedical sciences; 3 percent in the social sciences; and 1 percent in the arts, humanities, and professions). From the standpoint of migration, the most important distinction is the source of the PhD—United States or elsewhere. The proportion with foreign doctorates varies enormously by region of the world from which they came, and their post-training plans vary principally with source of doctoral training and secondarily by region of origin. The data with respect to these variations are provided in Table 3 and in Figure 2.

Table 3 presents the basic data for postdoctorals with U.S. and foreign PhD's, and the combination of both. The first column in each portion of the table gives the total number of postdoctorals by country (Canada is the only country separately specified) or region of citizenship. The second column gives the percentage of the total number from each country or region. Each successive set of three columns gives numbers of cases and two sets of percentages represented by these numbers: vertical percentage, or proportion in the column from each region; and horizontal percentage, or proportion of total. The first and second such sets of three columns refer to those with destinations unknown, and destinations known; these are expressed as a percentage of the grand total. The remaining columns have horizontal percentages calculated on the "Destination Known" column. They refer, successively, to the number remaining in the United States, the number returning to their home region, and the number going to a country outside of their home region. The relationships between these proportions for the "Destination Known" group are graphed in Figure 2.

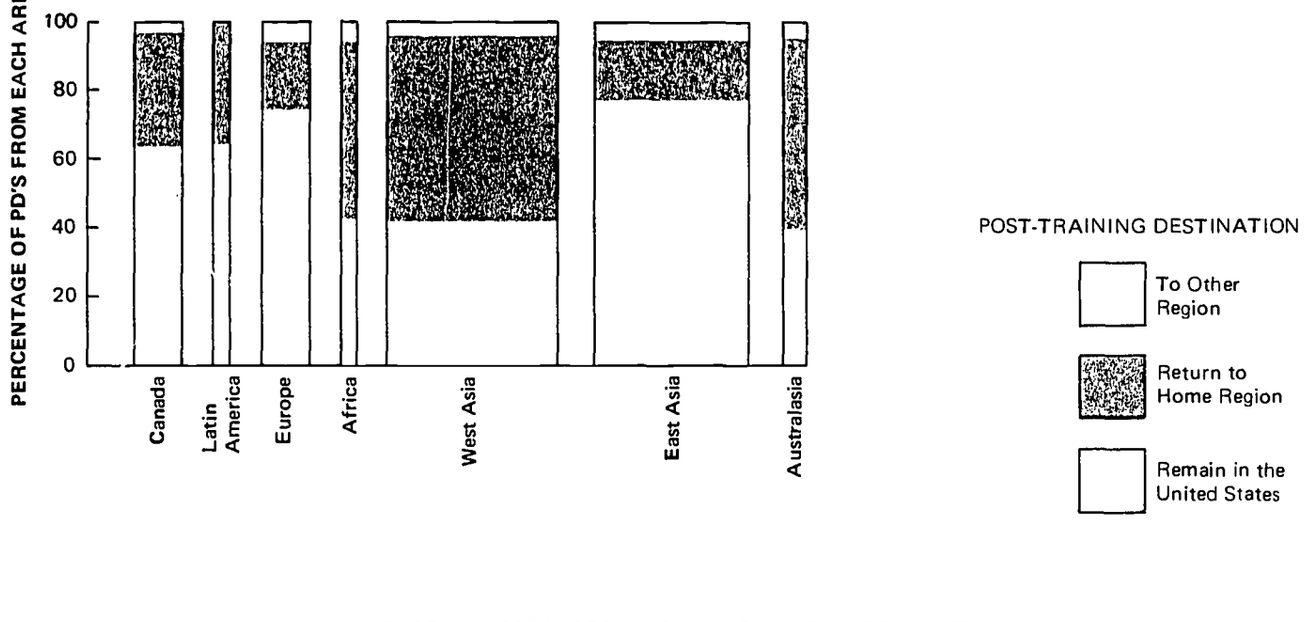
The data of Figure 2 are those for destinations of those postdoctorals who have definite plans for the period immediately after completion of training. As shown in Table 3, the postdoctorals with foreign doctorates have much more definite plans (88 percent), principally for returning home. Those who have been in the United States for some time, and have U.S. PhD's, are much less definite about what they will do when their training is finished (75 percent have definite plans). Many of those without post-training plans undoubtedly are hoping to remain in the United States, as their ties with their home countries have been weakened by absence, and they have acclimated themselves to the American scene. To the extent that such hopes might materialize, the differences between the U.S. and foreign PhD groups in Figure 2 would be heightened if it were possible to include eventual destinations for everybody in the graphs. The data displayed, however, are for those whose destinations were definitely planned at the time the data were collected in the fall of 1967.

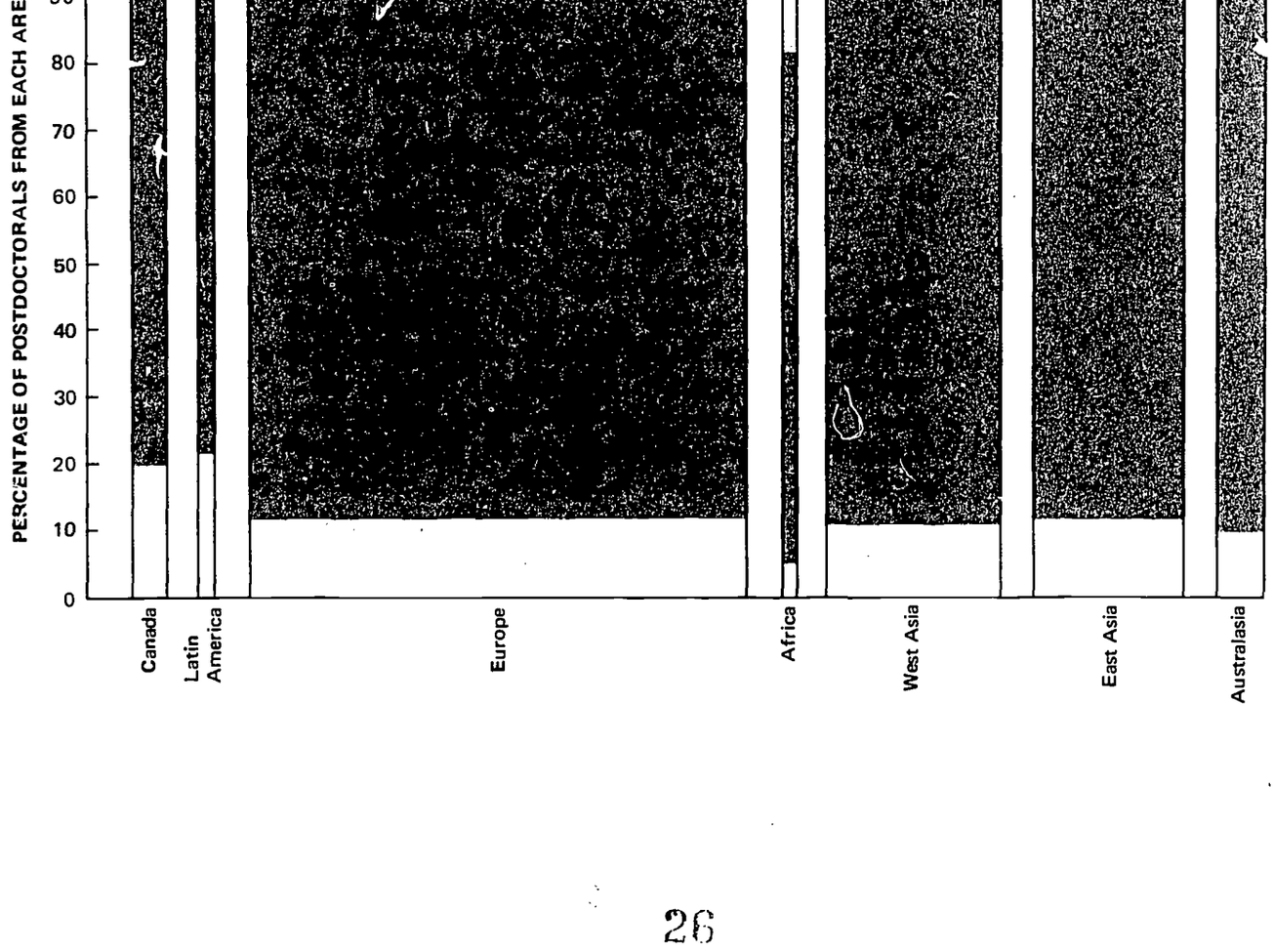
Figure 2 is divided into two portions to represent separately the two

[4] *The Invisible University: Postdoctoral Education in the United States* (Washington, D.C.: National Academy of Sciences, 1969).

FIGURE 2

Planned post-training destinations of postdoctorals (PD) of foreign citizenship, by source of PhD and world region of origin, for those with definite plans. (Data from Table 3.)





groups distinguished by source of PhD. As those with U.S. doctorates are only about one fifth of the total, the area of their chart is about one fifth of the total chart area. This was achieved by reducing both the horizontal and vertical dimensions. In each of the sets of graphs, the graph area devoted to those with citizenship from a given world region is proportional to the number of postdoctorals from that region. Each vertical bar is divided into segments showing planned post-training destination. The bottom portion of each bar represents those planning to remain in the United States. In the middle are those planning to return to their region of origin (not necessarily, but usually to their home country). The top portion of each bar represents those planning to go to some other country outside their home region.

Comparing the upper and lower portions of Figure 2 or the corresponding data of Table 3 shows immediately that most foreign postdoctorals with U.S. PhD's are Asiatic in citizenship, and plan to stay in the United States. Most of those with foreign PhD's are European and plan to return home; conversely, most European citizens with U.S. PhD's plan to remain in the United States (74 percent), while both East and West Asians with foreign PhD's plan to return to their home regions (87 percent). Many of these indicated on their questionnaires that they were on leave from teaching positions to which they would return. Canadians and Latin Americans with foreign PhD's are more likely than those from the eastern hemisphere to stay in the United States (20–22 percent), but if they have U.S. PhD's, they are still more likely to stay (64 percent). Africans, West Asians, and Australasians who have U.S. PhD's are the most likely of this group to return to their home regions (53–57 percent). The rather large percentage of Africans with foreign PhD's planning to go to some other region (17 percent) is not a reliable figure, as it is based on the decisions of only 4 persons out of a total group of 28.

It has been alleged by critics of statistics such as these that what a foreign student says on a questionnaire with respect to his plans following the completion of training cannot be taken at face value, because he is under pressure to return home, or to say that he will, and may not feel that it is safe to indicate his real plans. This factor cannot be directly assessed from the data at hand, but it is at least plausible that some such tendency is at work, and it would be expected to work in the direction of accentuating the differences between those with U.S. PhD's and those with foreign doctorates, in the directions here described. On the other hand, the comments on the questionnaires indicated, in general, a degree of candor that would not be expected if the respondents were anticipating that what they said would be held against them in any way.

ORIGINS, LEVELS, AND OPPORTUNITIES

Table 4 summarizes, from Table 1, the flow of students at various levels into the United States for higher education and advanced training. It may be interpreted something like this: Canadians represent roughly one in ten at all levels up to the postdoctoral, at which their proportion drops to one in thirty. Latin Americans are most numerous at the undergraduate level, where they constitute more than one fourth of the total. The Latin proportion then drops to one in eight at the professional and master's level, less than one in ten at the PhD level, and about one in a hundred at the postdoctoral level. Europe's proportion varies from one eighth to one sixth up to the postdoctoral level where it goes up to over one half of the total. East and West

TABLE 4

Relative Percentages of Foreign Students, by Level, from Various Regions of Origin, 1967–1968 Academic Year; and Postdoctoral Appointees, 1966–1967 (Foreign PhD's)[a]

Region of Origin	Undergraduate Students	Graduate Level Students			Postdoctoral Appointees
		Prof.	MA	PhD	
Canada	13.3	11.5	8.2	11.4	3.3
Latin America	27.1	12.8	13.2	7.8	1.4
Europe	12.6	16.2	13.1	15.0	53.4
Africa	6.9	6.1	6.0	6.2	1.0
West Asia	17.9	20.5	21.8	27.0	19.2
East Asia	18.8	26.0	32.3	27.2	16.6
Australasia	3.4	6.8	5.4	5.4	5.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[a]Data from Table 1.

Asia have roughly comparable proportions up to the PhD level, increasing from more than one sixth to more than one fourth from undergraduate to graduate school; it drops back again at the postdoctoral level to about one in five or six. Africa contributes about one sixteenth up to the PhD level, then one in a hundred for postdoctorals. Australasians come primarily for graduate, professional, and postdoctoral training (between one sixteenth and one twentieth of the total) but constitute only one thirtieth at the undergraduate level. This may reflect the expense of travel: It is a long way to come for undergraduate education, if schools at home are adequate, but perhaps worth the cost for professional training. The opposite trend for countries of the western hemisphere seems to confirm this effect: the influence of distance and cost versus gain in economic potential.

This general overview of migration of higher education students at various levels can indicate only some of the most general geographic, economic, and educational factors involved in international migration. The determining factors are undoubtedly numerous and many of them quite subtle. The remainder of this chapter will seek to explore in somewhat more detail some of the factors involved in a particular subgroup—those who attain doctoral degrees from United States universities but who, either before or after attaining the doctorate, have contact with a foreign country.

The opportunities for a person with brains, trained or untrained, to utilize them to his own advantage and/or to the advantage of his country are well known to vary drastically from time to time and country to country. A significant portion of the influx in the 1930's and 40's of people from central Europe who eventually attained United States PhD's represented refugees from Nazism. Similarly, following World War II, there was a large influx from eastern Europe, the countries behind the Iron Curtain. Perhaps these people came to the United States because they perceived the opportunities for their effective functioning—or for even remaining alive—as limited in the countries of their birth. Less drastic limitations are characteristic of many

countries, particularly the underdeveloped ones, for those with highly specialized skills. A country without accelerators can scarcely utilize effectively the skills of a person trained in high energy physics, for example. This raises a whole spectrum of questions with regard to the kind of training that is being, or that should be, provided people from various countries. By and large, the educational opportunities afforded by United States universities are geared to the American employment market. Does a sufficient variety of high-level training exist to meet the needs of people from all the foreign countries, and is there an adequate program for helping them in the wise choice of courses and levels of specialization so that they will be equipped with appropriate skills for returning home? Should there be an effort to provide these courses and this counseling? What is appropriate for the United States to do to improve the opportunities in the home countries for the effective utilization of U.S.-trained PhD's? This report will not attempt to resolve all of these issues, but it is hoped that the data here reported will illuminate some of the issues, which come increasingly to the fore when matters of policy with regard to immigration and the education of foreigners in the United States are considered.

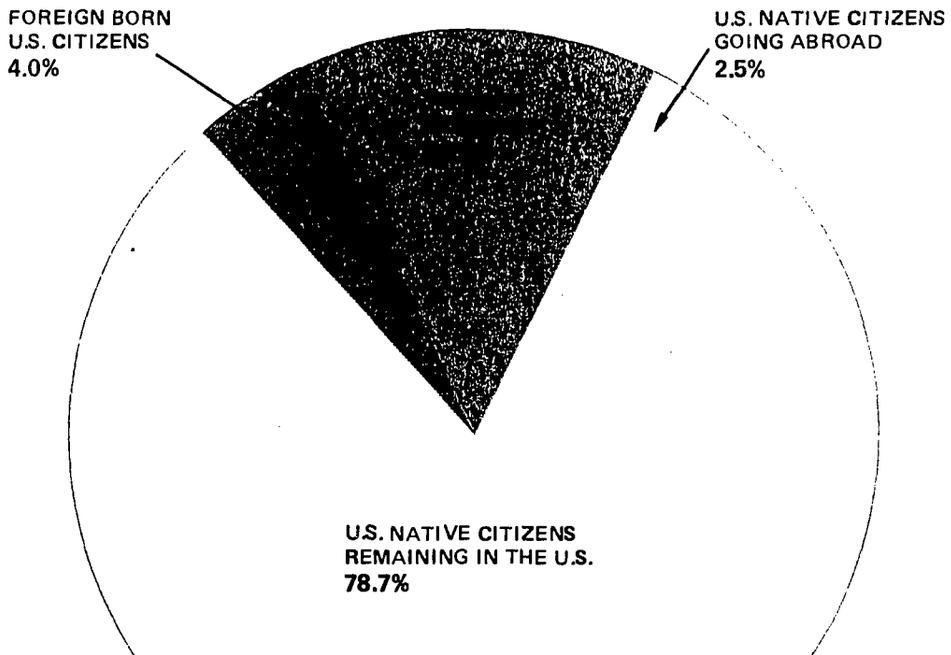
THE FOREIGN CONTACT GROUP OF U.S. PhD'S

During the period 1965–1968, the Doctorate Records File of the Office of Scientific Personnel shows that 72,280 people attained doctoral degrees in the United States. Of this group, approximately one fifth had, at some stage in their careers, been in a foreign country. The other four fifths (56,692), whom we will refer to hereafter as the "All-American" group, were born in and attended high school in the United States, took baccalaureate and doctoral degrees here, and expressed no plans to go abroad for postdoctoral employment. The one fifth whom we will call the "foreign contact group" includes those born or educated abroad and also those whose birth and education were in the United States, but who planned to go abroad for postdoctoral employment or training. Figure 3 depicts the relative proportions of U.S. doctorates of this period who were in these various groups.

Detailed data on the origins and destinations of the foreign contact group are available only for the PhD's of 1965–1968; these details are provided in Table 5, together with a notation of the All-American group for this same period. Less detailed information is available for those graduating over the whole 1960–1968 period, and the longer period will be used where details of place of birth, high school, baccalaureate, and post-PhD destination are not required. In Table 5, the numbers of individuals are shown on the left-hand page, and percentages on the right-hand page. For each country of birth, the number of U.S. PhD's is shown by citizenship status (U.S. vs. foreign), and for each of these groups, the number who had various levels of education in the United States, and the planned post-PhD destination (United States, foreign, or unknown). The data presented were derived from questionnaires (Survey of Earned Doctorates, Appendix K) administered routinely by the graduate schools of the United States and sent to the Office of Scientific Personnel of the National Research Council for statistical analysis. The information about post-PhD plans is reasonably accurate, insofar as any follow-up data indicate, but it is to be understood that the data concern intentions at the time the questionnaires were completed, not verified fact.

FIGURE 3

The foreign contact group as a portion of total U.S. PhD's 1965–1968. (Data from Table 5.)



OF ORIGINS AND DESTINATIONS

The flow into the United States of those who eventually attain doctorates here is by no means uniform from the various parts of the world, as shown in Table 5. Some people come to the United States prior to high school graduation—some, no doubt, in infancy. Others come between high school graduation and the baccalaureate, and still others only for graduate education. Some of those coming from abroad—principally those who come at an early age—take U.S. citizenship. Others never become and never intended to become U.S. citizens.

Various world regions of significance for the PhD group are shown in Table 5, which gives both educational background and later destinations. In this table, Europe is divided into five regions for historical, political, and linguistic reasons. Britain is presented separately, because of the importance of language, from the rest of northern Europe, which is mostly Scandinavian. North Europeans come here principally as adults, having had most of their education in their home countries. Those who come from central Europe (Austria, Germany, Italy, Malta), many of whom took U.S. citizenship, came mostly very early in their lives. Of the period here concerned, many came with parents who were refugees from the Hitler terror. Those born in eastern Europe who became U.S. citizens came a little later in their careers,

many, no doubt, being post-World War II refugees, as very few chose to return after the PhD. For both of these regions, those taking U.S. citizenship outnumber those who retained foreign citizenship. While this proportion is higher than elsewhere, undoubtedly a similar phenomenon is at work worldwide, and points up the importance of a distinction between refugee and brain-drain concepts. The distinction is blurred, of course, in the case of those who find on attaining the doctorate that there is really no adequate employment for them at home for educational, economic, or political reasons. Some of these people have taken training in fields for which there is a very limited opportunity in their home countries. Others find that the academic posts in which they would be able to make a contribution are all filled with people who have no intention of making room for them. Still others face political conditions that so limit their opportunities for freedom that they find it difficult or even dangerous to return home. The "push" and "pull" forces of expulsion from the home country and attraction by the United States, therefore, represent poles of a continuum, rather than clear-cut distinctions. In the course of this chapter we will discuss various factors that bear on this question, e.g., the field in which the PhD specializes, the relative wealth of the country of origin, and cultural and geographic factors such as lingual compatibility and travel distance.

Africa divides quite distinctly in these data into the three categories shown. Africa north of the Sahara is almost totally Arab and principally Egyptian in these statistics. The rest divides into black Africa and the Union of South Africa. Western Asia includes everything east of the Mediterranean as far as East Pakistan and is dominated here by India. Eastern Asia in these figures is dominated by Taiwan. Australasia includes all the Pacific islands except Japan, North Borneo, and Okinawa; the Philippines, Australia, and New Zealand (all English-speaking countries) are predominant here.

Data are available in the Doctorate Records File in somewhat less detail regarding the planned post-PhD destinations of foreign citizens from the various world regions, but not by individual countries. These data, shown graphically in Figure 4 include the proportions planning to stay in the United States, to return to their home region, to go to some other foreign region, or with plans unknown. In Figure 4 the width of each section of the graph is proportional to the number of people from each region; the destinations are shown by the vertical divisions. The contrast in destination proportions is striking, for example, in the four regional divisions of Europe, as discussed earlier. Africa is unique in the low proportion remaining in the United States and the high proportion returning to their home region, although Australasia is not far behind. Eastern Asia (chiefly Taiwan) is in marked contrast and is almost identical to Eastern Europe, with few returning to the home region, many more going to other foreign regions, and many remaining in the United States.

U.S. CITIZENS GOING ABROAD

The foreign destinations of United States citizens going abroad after the PhD are given in Table 6 in terms of numbers of cases and percentages. It is instructive here to consider two categories of people going abroad: those going as "postdoctorals" for further training in research techniques; and those going for regular jobs. For each of the foreign destination areas shown, the number of individuals involved is shown in the first three columns for totals,

TABLE 5

Level of Education in the United States and Planned Postdoctoral Destinations of 1965–1968 U.S. PhD's, by Region of Birth and Citizenship

Birthplace[a] and Citizenship	Numbers of U.S. PhD's of 1965–1968 by Citizenship							Percentage of U.S. PhD's of 1965–1968 by Citizenship[d]						
	Level of Education in U.S.				Planned Post-PhD Destination			Level of Education in U.S.				Planned Post-PhD Destination		
	High[b] School	Bacca-[c] laureate	PhD Only	Total Number	U.S.	Foreign	Unknown	High School	Bacca-laureate	PhD Only	Percent	U.S.	Foreign	Unknown
United States														
U.S.	56,692	175	1,828	58,695	47,928	1,819	8,948	97	—	3	100	82	3	15
F.	5	2	14	21	7	14	0	24	9	67	100	33	67	0
Foreign, Total														
U.S.	1,503	848	544	2,895	2,235	120	540	52	29	19	100	77	4	19
F.	109	1,256	9,304	10,669	4,645	3,691	2,333	1	12	87	100	43	35	22
Canada														
U.S.	128	32	55	215	171	9	35	59	15	26	100	80	4	16
F.	10	93	1,189	1,292	444	625	163	1	7	92	100	34	53	13
Latin America														
U.S.	113	46	35	194	154	6	34	58	24	18	100	79	3	18
F.	24	133	490	647	215	320	112	4	20	76	100	33	50	17
Great Britain														
U.S.	88	41	32	161	132	10	19	55	25	20	100	82	6	12
F.	6	22	453	481	234	180	67	1	5	94	100	49	37	14
Other N. Europe														
U.S.	21	20	13	54	42	2	10	39	37	24	100	78	4	18
F.	0	29	123	152	73	57	22	0	19	81	100	48	37	15
Western Europe														
U.S.	130	80	42	252	193	0	49	51	32	17	100	77	4	19
F.	7	50	356	413	188	143	82	2	12	86	100	45	35	20
Central Europe														
U.S.	416	161	75	652	501	32	119	64	25	11	100	77	5	18
F.	11	81	317	409	208	113	88	3	20	77	100	51	28	21

Eastern Europe														
U.S.	373	277	151	801	619	27	155	46	35	19	100	77	3	20
F.	7	77	338	422	232	32	96	2	18	80	100	55	22	23
North Africa														
U.S.	1	5	7	13	13	0	0	8	38	54	100	100	0	0
F.	0	13	540	553	116	309	128	0	2	98	100	21	56	23
Union of S. Africa														
U.S.	1	3	5	9	5	0	4	11	33	56	100	56	0	44
F.	0	1	94	95	22	59	14	0	1	99	100	23	62	15
All Other Africa														
U.S.	11	10	2	23	22	0	1	48	43	9	100	96	0	4
F.	2	69	155	226	45	140	41	1	30	69	100	20	62	18
India														
U.S.	16	14	12	42	31	0	11	38	33	29	100	74	0	26
F.	1	33	1,694	1,728	800	417	511	—	2	98	100	46	24	30
Other West Asia														
U.S.	50	57	29	136	94	9	33	37	42	21	100	69	7	24
F.	5	223	937	1,165	462	405	298	—	19	81	100	40	35	25
Taiwan														
U.S.	89	52	59	200	152	9	39	44	26	30	100	76	5	19
F.	16	137	1,220	1,373	906	92	375	1	10	89	100	66	7	27
Other East Asia														
U.S.	41	41	10	92	70	2	20	45	44	11	100	76	2	22
F.	17	264	810	1,091	511	325	255	2	24	74	100	47	30	23
Australasia														
U.S.	25	9	17	51	36	4	11	49	18	33	100	70	8	22
F.	3	31	588	622	189	352	81	1	5	94	100	30	57	13
Grand Total	**58,309**	**2,281**	**11,690**	**72,280**	**54,815**	**5,644**	**11,821**							

[a]See footnotes to Table 6 for definitions of countries included in each area.
[b]U.S. high school, baccalaureate, and doctorate.
[c]Foreign high school, U.S. baccalaureate and doctorate.
[d]0 = none; — = less than 0.5 percent.

FIGURE 4

Planned post-PhD destinations of PhD's of foreign citizenship, 1960–1967. Note that the size of region of origin is proportional to number of PhD's from that area.

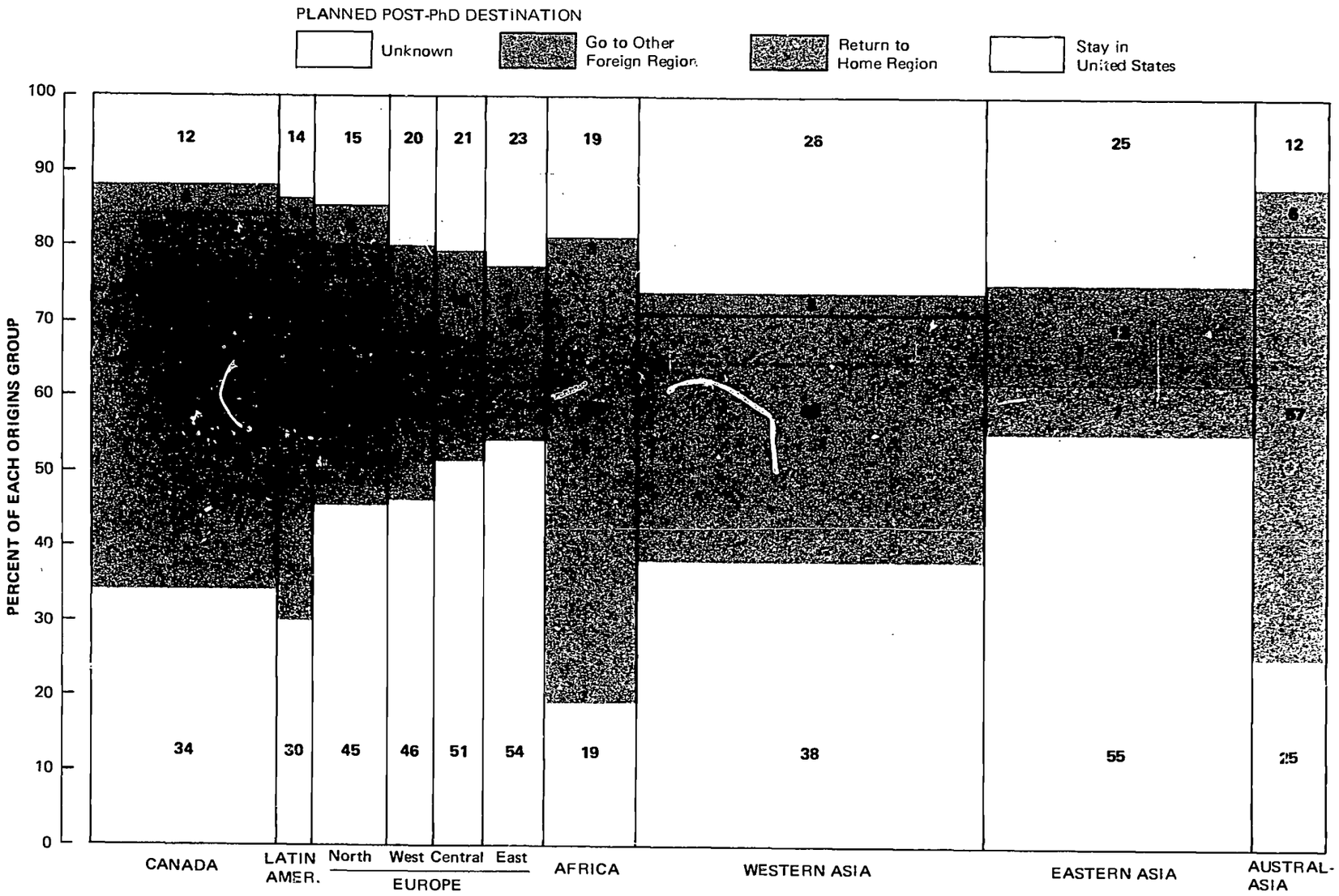


TABLE 6

Foreign Destinations of U.S. Citizens Going Abroad for Postdoctoral Training and Employment, FY 1965-1968

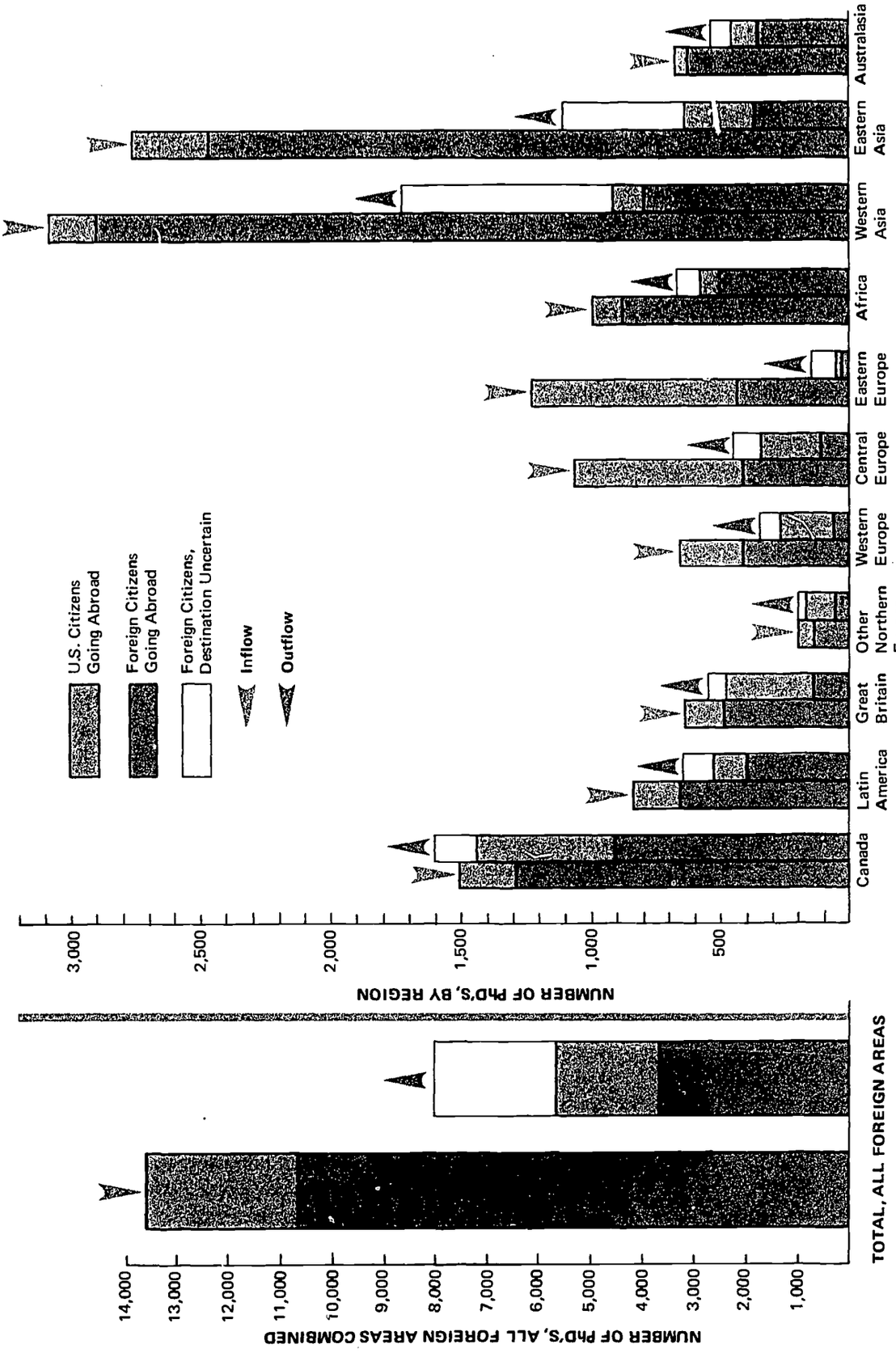
Area or Country of Destination	Number of People Going			Horizontal Percentages		Vertical Percentages		
	Total Number	For Training	For Empl.	Training	Jobs	Total	Training	Jobs
Total all areas	**1,978**	**904**	**1,074**	**46**	**54**	**100.0**	**100.0**	**100.0**
Canada	531	75	456	14	86	26.8	8.3	42.5
Latin America	130	13	117	10	90	6.6	1.4	10.9
Great Britain	337	269	68	80	20	17.0	29.8	6.3
Other North Europe[a]	118	98	20	83	17	6.0	10.8	1.9
Western Europe[b]	246	189	57	77	23	12.4	20.9	5.3
Central Europe[c]	201	153	48	76	24	10.2	16.9	4.5
Eastern Europe[d]	20	16	4	80	20	1.0	1.8	0.4
Africa	80	8	72	10	90	4.0	0.9	6.7
Western Asia[e]	120	32	88	27	73	6.1	3.5	8.3
Eastern Asia[f]	104	13	91	13	87	5.3	1.4	8.5
Australasia[g]	91	38	53	42	58	4.6	4.2	4.9

[a]British Isles, Scandinavia, Finland.
[b]Belgium, France, Netherlands, Switzerland, Luxembourg, Spain, and Portugal.
[c]Germany, Austria, Italy, Malta.
[d]Greece, Yugoslavia, and the "Iron Curtain" countries.
[e]Asia from the Mediterranean to East Pakistan, inclusive.
[f]Mainland Asia from Burma eastward, plus Ceylon, Japan, North Borneo, and Okinawa.
[g]Australia, New Zealand, Indonesia, Philippine Islands, Borneo, Guam, Samoa.

postdoctoral training, and employment, respectively. The next two columns show, for each country, the percentage division into the training and job categories. The final three columns give vertical percentages, i.e., within each category of activity, the percentage going to each country. Over-all, the division into the two activity categories is nearly even: 46 percent going abroad for further training and 54 percent for employment. These proportions vary tremendously for the several destinations, however. U.S. citizen PhD's go to Canada, Latin America, Africa, and Asia primarily for regular jobs. Of all those going abroad, more than one fourth go to Canada; Britain comes next with 17 percent. Thus, almost half of them go to the English-speaking countries, including Australasia, which is dominated by Australia, New Zealand, and the Philippine Islands where English dominates. The rest of Europe takes about 30 percent, leaving only 22 percent for all the rest of the world. This "rest of the world"—Africa, Asia, and Latin America—absorbs 34 percent of those going abroad for employment and only 7 percent of those seeking further training. Of those going abroad for further training, fully 80 percent go to Europe. The reasons for these differences lie in the availability of high-quality universities and research centers, language (relatively few PhD's have an effective command of a foreign language, in spite of formal requirements in this area), and the need of the developing countries for importation of specialists for technological enterprises and, to a lesser extent, for American professors. The temporary nature of this exodus of U.S. citizens should be stressed: The postdoctoral training is typically of 1 or 2 years' duration, and much of the regular employment is also temporary but of unknown duration as far as present statistics are concerned.

FIGURE 5

Inflow from and outflow to each world region of birth and of post-PhD destination, U.S. PhD's of 1965–1968. (Data from Table 7.)



INFLOW AND OUTFLOW BY WORLD REGION

The interchange with each of the major world regions is shown graphically in Figure 5 and numerically in Table 7. The wide bars in the left portion of Figure 5 show the over-all total of inflow and outflow. The first bar denotes inflow from all over the world of those who took U.S. PhD's in the 1965–1968 period. The bottom portion shows those who remained citizens of foreign countries at least until after completion of the doctorate. The top portion of this bar shows the proportion (about one fifth) who became U.S. citizens. The second wide bar shows outflow during the same 1965–1968 period, using the same color designations of U.S. and foreign citizens. It must be remembered that these U.S. citizens leaving the country are mostly U.S. natives; only a very small portion are the same people depicted in the left-hand bar as incoming and obtaining U.S. citizenship. Above the colored portion of the bar, which represents total outflow, is an extension made of dashed lines. This represents the number of foreign citizens who, at the time of completing their doctorate survey questionnaires, did not know what their destinations would be immediately after the doctorate. They, thus, represent potential outflow of foreign citizens. Although, many of them do eventually go abroad again, many remain in the United States. What the proportions of these two groups will be cannot be ascertained at this point.

The right-hand portion of Figure 5 is constructed in the same way as the "total" diagram at the left, but broken out by region of the world from which and to which the PhD's flow. The first pair of bars represents Canada. Here the inflow and outflow bars are nearly in balance, in part because of U.S. citizens going there for either employment or postdoctoral training. From Latin America also the inflow is not far out of balance with the outflow to that region. The outflow from the United States to northern and western Europe of U.S. PhD's who are citizens of those areas represents only one third of those coming to the United States from there; a very large portion of U.S. citizens going abroad almost makes up the balance. There is a maximum disparity between inflow from and outflow to eastern and central Europe. Those U.S. PhD's coming from these areas are apparently largely refugees, and many become U.S. citizens. Africa achieves a return flow of its citizens that is about the same as for Latin America. In contrast, however, very few Africans become U.S. citizens, and few U.S. citizens go there after the doctorate. The same is true of Asia. Western Asia, which is dominated by India, has an outflow of U.S. PhD's—only a little over one third of the inflow from there. The situation is similar with respect to eastern Asia, which is dominated by Taiwan, except that the return flow to eastern Asia is even less—about one fifth of the inflow of eventual PhD's from that area. A very large proportion of both East and West Asians do not have definite plans at the time of completion of the doctorate survey questionnaire. No doubt a very large proportion are hoping to find U.S. employment or postdoctoral appointments. The final pair of bars represents Australasia, which includes most of the Pacific islands, but is dominated by the Philippines, Australia, and New Zealand. The inflow–outflow diagram for this area resembles that for Canada on a reduced scale, with a smaller percentage of those from Australasia becoming U.S. citizens.

In assessing the significance of the balance, or lack of balance, between inflow and outflow as it affects a particular foreign area, the intended function of the U.S. citizens going abroad is important. Thus, Table 6 and Figure 5

TABLE 7

Character of In-Migration from and Out-Migration to Each World Area, U.S. PhD's of 1965-1968

Origin or Destination	Inflow to U.S.A.			Outflow from U.S.A.			Foreign Citizen from Each Origin with Destination Uncertain	
				To Each Area as Destination				
	Eventual U.S. Citizen	Foreign Citizen	U.S. + Foreign Total	U.S. Citizen	Foreign Citizen	Total		
Total All Foreign Areas	**2,895**	**10,669**	**13,564**	**1,978**	**3,737**	**5,715**	**2,333**	**17.2%**
Canada	215	1,292	1,507	531	909	1,440	163	10.8%
Latin America	194	647	841	130	403	533	112	13.3%
Great Britain	161	481	642	337	144	481	67	10.4%
Other N. Europe	54	152	206	118	61	179	22	10.7%
Western Europe	252	413	665	246	110	356	82	12.3%
Central Europe	652	409	1,061	201	70	271	88	8.3%
Eastern Europe	801	422	1,223	20	35	55	96	7.8%
Africa	45	874	919	80	495	575	183	19.9%
Western Asia	178	2,893	3,071	120	791	911	809	26.3%
Eastern Asia	292	2,464	2,756	104	362	466	630	22.9%
Australasia	51	622	673	91	357	448	81	12.0%

need to be considered together. With respect to Canada, for example, relatively good balance is achieved chiefly by U.S. citizens going to Canada for regular employment. Canada is nearby, well-known, with language and customs very like those of the United States, and is in effect part of a combined academic marketplace. This is not true of the other countries. Britain contrasts with Canada in having many U.S. citizens go there for temporary postdoctoral fellowships in its excellent universities, in which they encounter no language handicap. Employment for U.S. PhD's is scarce, however, (as indeed it appears to be for British PhD's, to judge by articles in the science and technology press). Northern Europe other than Britain has a similar inflow–outflow pattern, but on a reduced scale, while the other parts of Europe are far out of balance, the total outflow failing even to equal the inflow of foreign citizens to the United States. Those Americans who do go to these parts of Europe are seeking training rather than employment by ratios of three and four to one. It must be acknowledged, however, that the value to a host country of these postdoctorals, while debatable, is certainly not negligible. Typically, a postdoctoral fellow or research associate performs some research that should be useful to the host country as well as to himself, and may do some valuable teaching, or bring to the host institution or laboratory some valuable ideas and techniques. Foreign nationals coming to the United States make a similar contribution, which may be equally valuable to the United States, perhaps on a less transient basis.

For the other regions of the world, U.S. citizens going abroad are mostly seeking employment rather than training, but their numbers are insufficient to redress the balance of inflow from those areas. This is true of all other areas except Australasia, where U.S. citizens going there for employment al-

most exactly balance the immigrants from that area who become U.S. citizens, while in addition a slightly smaller number go there for postdoctoral training.

NATIONAL PER CAPITA WEALTH AND MIGRATION

A consideration of the drain on a country when a person educated there goes elsewhere is much more complicated than it seems initially. In a very poor country with meager facilities for education beyond the elementary grades, the loss of a secondary-school graduate may be as important as the loss of a PhD is to the United States. In fact, a bright secondary-school graduate may be much more useful to such a country than is the same man after he has attained specialized PhD training for which there is no employment in his home country. His expensive training may maladapt him to his home environment. The expense of this training must also be considered in several categories: the cost of tuition and fees and maintenance, and the cost of earnings foregone during training. It is common knowledge that tuition and fees do not cover the actual costs to a university; therefore the sources of general support for the university bear part of the cost of the man's education. Earnings foregone may be small, if the alternative employment beyond high school would be that afforded by a very poor economy. In fact, part-time employment in the United States while pursuing higher education may well surpass full-time earnings in the home country in some cases. The situation is somewhat different in the countries with more advanced economies and educational systems. This report does not try to assess the relative costs at each level for people from the various categories of countries but merely notes that the problem is by no means a simple one. The losses to the home country in intellectual potential are important, but must be balanced against the similar loss in underdevelopment of that talent when the home country could not itself provide the education such latent talent requires to become maximally productive. The loss to the individual is another matter, and it is easy to overlook an international balance of payments, as it were, in human capital. The basic philosophy of individual opportunity, which this country has historically afforded to immigrants and the pay-off of such a policy of opportunity, must not be overlooked. Not only the individuals involved, but the United States, and, eventually the world, have been enriched by this "free trade" policy. Any realistic assessment of the brain-drain question must take into account the economic, political, and individual effects of this policy, and the costs, as well as benefits, of any change in it.

With these ideas in the background, but without any attempt to treat them quantitatively, this report will proceed to an analysis of the inflow and outflow of people who attain the PhD in the United States in terms of countries sorted into categories along an economic scale.

Countries may be divided into groups of varying degrees of wealth by computing a figure for the gross national product of goods and services and divided by that country's population. For the purposes of the present report, we have used World Bank data[5] to establish six groups of foreign countries: rich, well-to-do, average, below average, poor, and very poor. The

[5]Escott Reid, *The Future of the World Bank*, (Washington, D.C.: International Bank for Reconstruction and Development, 1965). More recent data might change some dollar values, but would not significantly affect the grouping of nations, and would be less relevant to the time period with which we are concerned.

TABLE 8

Destinations of 1965–1968 U.S. PhD's of Foreign Citizenship by Wealth Category of Birthplace

Wealth Category of Birthplace[b]		Total in Each Category	Foreign Citizen PhD's by Postdoctoral Destination[a]: As Proportion of Total — Destination Unknown	As Proportion of Total — Destination Known	As Proportion of Known Destination — Remain in U.S.	As Proportion of Known Destination — Foreign Country	As Proportion of Foreign Destination — Home Region[c]	As Proportion of Foreign Destination — Other Region[c]	Foreign Citizen PhD's by Wealth of Foreign Country of Destination — Very Poor	Poor	Below Average	Average	Well-to-do	Rich
Very poor	N	2,328	635	1,693	961	732	664	68	**643**	23	5	8	8	45
(Below 100)	%	21.3	27.3	72.7	56.8	43.2	90.7	9.3	**87.8**	3.1	0.7	1.1	1.1	6.1
Poor	N	3,084	768	2,316	1,460	856	787	69	2	**769**	14	9	16	46
(100–199)	%	28.3	24.9	75.1	.63.0	37.0	91.9	8.1	0.2	**89.7**	1.6	1.1	1.9	5.4
Below average	N	852	191	661	355	306	272	34	3	6	**263**	11	9	14
(200–399)	%	7.8	22.4	77.6	53.7	46.3	88.9	11.1	1.0	2.0	**85.9**	3.6	2.9	4.6
Average	N	1,476	285	1,191	631	560	439	121	6	13	6	**451**	34	50
(400–999)	%	13.5	19.3	80.7	53.0	47.0	78.4	21.6	1.1	2.3	1.1	**80.5**	6.1	8.9
Well-to-do	N	1,780	312	1,468	830	638	393	245	12	15	9	27	**444**	131
(1,000–1,999)	%	16.3	17.5	82.5	56.5	43.5	61.7	38.3	1.9	2.3	1.4	4.2	**69.5**	20.5
Rich[d]	N	1,386	177	1,209	488	721	638	83	4	1	4	13	47	**652**
(2,000–3,089)	%	12.7	12.8	87.2	40.4	59.6	88.5	11.5	0.6	0.1	0.6	1.8	6.5	**90.4**
Total all countries	N	**10,906**	**2,368**	**8,538**	**4,725**	**3,813**	**3,193**	**620**	**670**	**827**	**301**	**519**	**558**	**938**
	%	**99.9**	**21.7**	**78.3**	**55.3**	**44.7**	**83.7**	**16.3**	**17.6**	**21.7**	**7.9**	**13.6**	**14.6**	**24.6**

[a] Each pair of untinted columns sum to the preceding total, i.e., unknown and known sum to grand total; remain in U.S. and to foreign country sum to known total; home region and other region sum to foreign total. The last six columns, by wealth of country of destination, recapitulate the foreign group and sum to the foreign total.
[b] The figures in parenthesis define the gross national product per capita (GNP/C).
[c] Regions are continents, except that Europe and Asia are subdivided. See Table 6 for nations included in each region.
[d] The rich category includes only Canada, Switzerland, and Sweden, with GNP/C over $2,000 but less than the U.S. rate of $3,090.

United States, with a gross national product per capita (GNP/C) higher than any of the others (Kuwait is not included in these data), is considered in a separate category, as it is U.S. PhD's who are the entire area of concern here. Table 8 gives the basic data on numbers and percentages of foreign citizens from countries in each wealth category who remain in the United States or return to their home country or to some other foreign country. The wealth categories of the destination countries are as follows (the country names given below are not all the current names, but often the older ones, applicable when recent PhD's grew up there):

Rich: *GNP/C over $2,000 per annum*
Canada, Sweden, Switzerland

Well-to-do: *GNP/C $1,000–$1,999 per annum*
Australia, Austria, Belgium, Czechoslovakia, Denmark, Finland, France, Germany, Iceland, Israel, Luxembourg, Netherlands, New Zealand, Norway, United Kingdom, USSR (and, by inference, the Baltic countries absorbed by the USSR after World War II)

Average: *GNP/C $400–$999 per annum*
Argentina, Bermuda, British West Indies, Bulgaria, Chile, Cuba, Cyprus, Greece, Hungary, Ireland, Italy, Japan, Malta, Mexico, Okinawa, Panama, Poland, Rumania, Spain, Union of South Africa, Uruguay, Venezuela

Below Average: *GNP/C $200–$399 per annum*
Central and South America (other than those in the average and poor categories), Guam, Hong Kong, Iran, Iraq, Jordan, Lebanon, Libya, Malaya and Singapore, Portugal, Samoa, Turkey, Yugoslavia

Poor: *GNP/C $100–$199 per annum*
Algeria, Bolivia, Brazil, Cambodia, Ceylon, Egypt, Gaza Strip, Korea, Liberia, Morocco, North Borneo, Paraguay, Philippine Islands, Saudi Arabia, South Vietnam, Sudan, Syria, Taiwan, Thailand, Tunisia

Very Poor: *GNP/C below $100 per annum*
Afghanistan, Borneo, Burma, India, Indonesia, Laos, Nepal, Pakistan, Haiti, and Africa south of the Sahara (except the Union of South Africa)

Noteworthy in Table 8 is the fact that the proportion of those with uncertain plans increases with poverty of country of origin–an understandable phenomenon. The percentage planning to remain in the United States is not clearly correlated with wealth of country of origin and varies moderately except for the "rich" category, which is principally Canada. An exceptionally large percentage of the Canadians plan to return home. Another noteworthy fact is that the percentage planning to go to some foreign region (not country) other than their own is not large, but does increase directly with wealth of country of origin except for the "rich" category.

The interplay of geographic with cultural and ethnic factors is such as to preclude clear-cut conclusions on the basis of the national economic level alone. Canada is a good example. Crossing the U.S.–Canadian border in

either direction is easy and involves no great cultural or language adaptations. Furthermore, the Canadian and U.S. economies are closely related and similar in GNP/C level. This would explain their staying in Canada rather than moving to another and less prosperous region. Crossing the Atlantic to or from Europe is more difficult; the European economies, in general, are less prosperous and employment opportunities for new PhD's perhaps less inviting. But migration within Europe, which in the terms here employed includes four different "regions," is easier than migration to any of the other regions of the world, either from Europe or from the United States. Cultural and economic variations from the U.S. or European pattern are even greater for Africa or Asia. Australasia, on the other hand, is in these figures dominated by the English-speaking countries of the Philippines, Australia, and New Zealand, so that the cultural barriers are minimal, while the distance from the United States is maximal.

In spite of the complex interplay of these factors, some conclusions may nevertheless be drawn from an array based on national wealth. A recapitulation of some of the data from Table 8 gives a clearer picture of the amount of upward movement of national economies and the countervailing movement down this scale. These figures are given in Table 9.

In Table 9 attention may profitably be concentrated on those countries ranging from "poor" to "well-to-do," for whom a significant degree of movement either up or down is possible for those who leave the United States. (Those in the rich category can move up, and those in the very poor category can move down but only within these single categories.) The general trend is for those from the higher income countries to have more mobility in both directions: About 40 percent of those from well-to-do countries move either up or down the economic scale, while only 10 percent of those from poor countries do so. But the general mobility trend is upward: 12.7 percent move up as compared to 5.8 percent who move down. The rich and the poor

TABLE 9

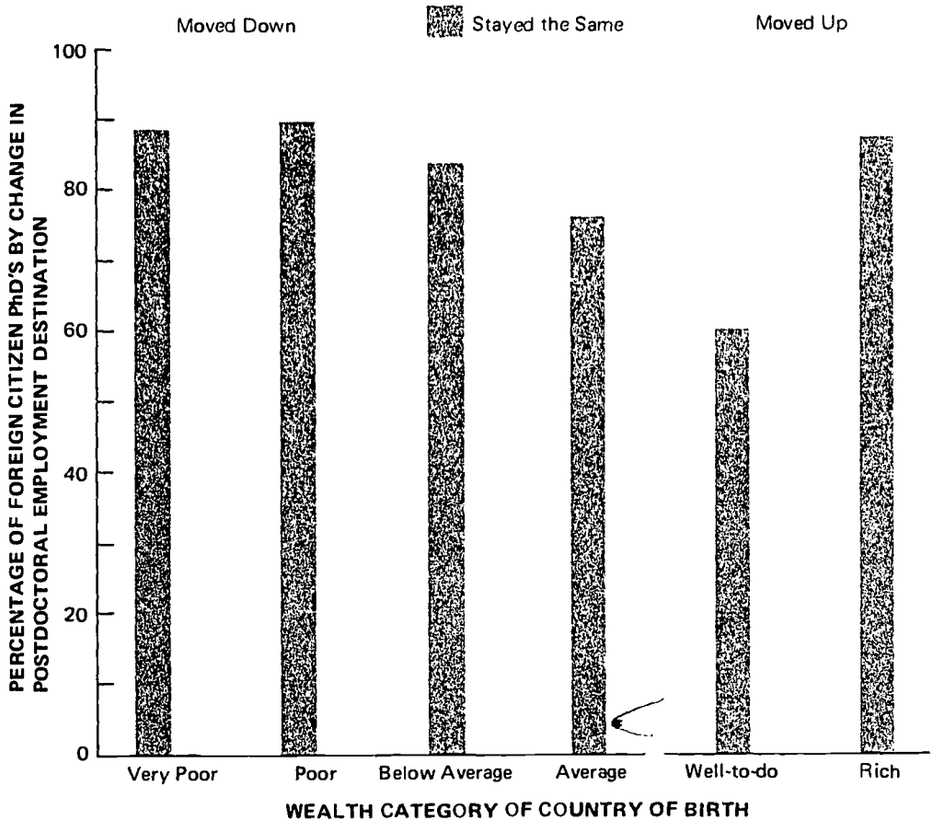
Numbers of PhD's Remaining in the United States, and Numbers Moving to More Prosperous and Less Prosperous Economies, by Wealth Categories of Country of Origin, 1965-1968 Foreign Citizens

Wealth of Country of Birth	Total Cases Whose Movement Is Known	Remain in U.S.	Total to Foreign Regions	Foreign Destinations[a]					
				Moving Down		Staying Same		Moving Up	
				N	%	N	%	N	%
Total	**8,540**	**4,725**	**3,815**	**221**	**5.8**	**3,109**	**81.5**	**483**	**12.7**
Rich	1,209	488	721	84	11.7	631	87.5	6	0.8
Well-to-do	1,469	830	639	91	14.2	383	59.9	164	25.7
Average	1,191	631	560	33	5.9	426	76.1	101	18.0
Below average	661	355	306	11	3.6	257	84.0	38	12.4
Poor	2,317	1,460	857	2	0.2	769	89.7	85	9.9
Very poor	1,693	961	732	0	0.0	643	87.8	89	12.2

[a]Percentages on foreign destinations are based on total foreign destinations.

FIGURE 6

Change in foreign country category from birth to postdoctoral employment.



tend to stay at their own ends of the scale. The moves up and down the economic scale, for each wealth category, are shown in Figure 6.

FIELD MIX FOR FOREIGN AND U.S. CITIZENS

Up to this point, all fields of doctorate have been combined, although allusion has been made to the question of the appropriateness of the training some foreign PhD's receive, from the standpoint of utilizing this training in their home countries. It is interesting to contrast the distribution of fields of PhD specialization by the All-American group to that of the foreign citizen group. A further break-out by wealth category of country of origin of the foreign PhD's is also instructive. Table 10 gives the necessary data, and Figure 7 illustrates the stiuation graphically.

The most striking differences between the American and foreign field distributions are in the much larger proportions of foreigners in the engineering and agriculture fields and smaller proportions in the humanities–arts–professions (H–A–P) group. In agriculture, the relative percentages are 2.2 percent for the American group vs. 5.9 percent for the foreign citizen group. In engineering the percentages are 11.1 vs. 20.9 percent, respectively, while in the H–A–P fields the reverse is true: 34.8 percent for U.S. citizens, and 17.1 percent for foreign citizens. This latter contrast is quite understandable,

TABLE 10

Field Distributions of 1965-1968 "All-American" PhD's, Americans Going Abroad, and Foreign Citizens, by Wealth of Country of Origin

Origin's Group		Unknown Field	Known Total All Fields	Math, Physical Sciences	Eng.	Agr.	Bio-medical Sciences	Social Sciences	H-A-P
U.S. PhD's,	N	–	49,628	10,036	5,501	1,077	6,080	9,674	17,260
"All-American"	%		100	20	11	2	12	20	35
Foreign citizens,	N	31	10,660	2,414	2,237	632	2,512	1,680	1,817
Total	%		100	22	21	6	18	16	17
Rich (A)	N	15	1,371	288	175	48	183	292	385
	%		100	21	13	4	13	21	28
Well-to-do (B)	N	3	1,725	375	283	84	229	302	452
	%		100	22	16	5	13	18	26
Average (C)	N	2	1,333	304	246	87	334	211	238
	%		100	23	18	6	19	16	18
Total prosperous	N	20	4,429	967	704	219	659	805	1,075
(A + B + C)	%		100	22	16	5	15	18	24
Below average (D)	N	3	829	170	191	80	226	129	113
	%		100	20	23	10	17	16	14
Poor (E)	N	4	2,993	712	853	151	728	376	324
	%		100	24	28	5	19	13	11
Very poor (F)	N	4	2,409	565	484	182	680	370	305
	%		100	23	20	8	21	15	13
Total poor	N	11	6,231	1,447	1,533	413	1,221	875	742
(D + E + F)	%		100	23	25	7	19	14	12
U.S. citizens	N	–	1,996	574	159	41	467	375	378
going abroad	%		100	29	8	2	23	19	19

as the fields in this group deal predominantly, although not exclusively, with the American culture. Education is included here, and a very small proportion of the education majors are foreigners. Most of the educators are people who are deeply rooted in the American educational system, and the program of studies involved here seems to have little export value. Engineering and agriculture, by contrast, enlist over twice as large a proportion of foreigners as Americans. These applied fields are particularly important in the less-developed countries from which the majority of foreign PhD's come. Similarly, the biomedical science fields are highly important to foreign countries; here, the percentage of PhD's is considerably higher than in the All-American group (17.7 vs. 12.3 percent). The social sciences component is much smaller (15.8 vs. 19.5 percent), and the math-physical sciences group somewhat larger than for the Americans. The latter appears to be a field in which a good deal of discrepancy might develop between the training of the scientists involved and the opportunities back home to employ their skills. For this reason, it is particularly interesting to consider the relationship between national wealth and field of PhD, as shown in the lower portion of Table 10 and in Figure 7.

FIGURE 7

Field mix of U.S. and foreign citizen groups, 1965-1968 PhD's. (Data from Table 10.)

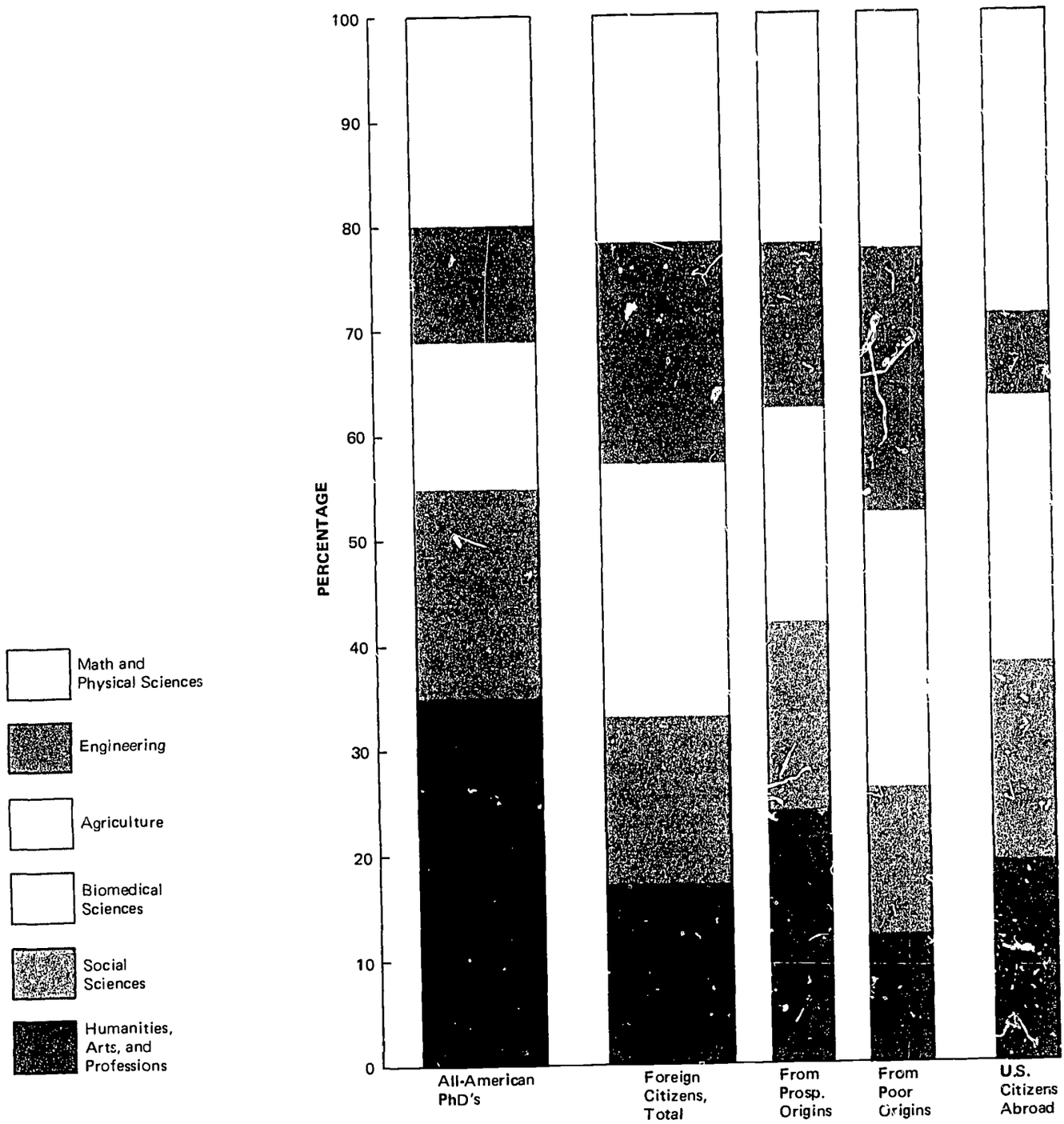


Figure 7 depicts the proportions of the All-American and foreign citizen groups in each of the six fields and also groups the foreign citizens by wealth of country of citizenship. The three most prosperous categories are shown in the third bar, the three least prosperous categories in the fourth bar. The fifth bar shows the field distribution of U.S. citizens going abroad (about half for postdoctoral training). The All-American vs. foreign origins contrasts in Figure 7 have been noted above. Within the foreign group, the comparison of the more prosperous with the less prosperous countries shows that the latter are relatively much stronger in engineering (25 vs. 16 percent), somewhat stronger in agriculture (7 vs. 5 percent) and biomedical fields (19 vs. 15 percent), and relatively much weaker in the humanities–arts–professions fields (12 vs. 24 percent). This appears to be in accord with the evident needs of the developing countries that are more agricultural, have greater needs for engineers for development of basic resources (roads, mines, factories), and have health problems for which local training resources are relatively less adequate. On the other hand, their needs for American-trained humanists can be deferred to a later stage of development, especially inasmuch as the cultures of these countries are probably, as a group, less closely related to that of the United States than the more prosperous countries, which are principally European.

The bottom line of Table 10 and the fifth bar in Figure 7 depict the field distribution of American citizen PhD's going abroad; about half go for postdoctoral training and half for regular employment. They are relatively much more concentrated in mathematics and the physical sciences and biomedical sciences, and less in engineering than any of the other groups, and much less numerous in the humanities–arts–professions group than the U.S. PhD's who stay at home. In agriculture and social sciences, they are equal to the U.S.-origins norm. As noted earlier (see Table 6) those who are going abroad for further training are going primarily to Europe; those who are going into regular employment go principally to the Americas, including Canada, and secondarily to Asia. With postdoctoral training being confined principally to the natural sciences, this indicates that the Europe-bound people are predominantly bioscientists and physical scientists going there for further training; the social scientists and humanists are more evenly distributed, and are probably mostly going into teaching positions.

CHAPTER II HISTORY AND GEOGRAPHY OF U.S. DOCTORATE OUTPUT

Migration within the United States exhibits some of the same kinds of phenomena found in international migration. There are regions that have better-developed educational systems, regions of greater and lesser economic prosperity, and massive interregional migrations. Fortunately, for a study of this sphere, we have a longer time series on doctorate production and the baccalaureate origins of PhD's and far more extensive, comparable, and dependable data on which to compare the various states in contrast to the uncertain data about the various countries of the world. There are, of course, relatively few barriers to interstate migration as compared to international migration. One encounters, nevertheless, problems of an "internal brain drain" and such questions as "who pays for graduate education and who profits by it?" It is the aim of the remaining chapters to provide a strong factual base upon which consideration of these questions might rest. At the same time it is recognized that many more questions—both of substance and of technique—will be raised in the course of these chapters than can be answered.

MAJOR CHANGES FROM THE 1920's TO THE 1960's

Early in the twentieth century, doctorate production was concentrated in a few graduate schools. Toward the end of the first quarter of this century (1920–1924), the northeastern section of the country produced about three fourths of all PhD's: 18 percent in New England, 28 percent in the Middle Atlantic states, and 28 percent in the East North Central section. The South and West produced less than 20 percent. The states of the "Old South" (i.e., South Atlantic and East and West South Central regions) graduated only 1.5 percent of the U.S. PhD's, the Rocky Mountain states less than one fourth of 1 percent. In 1968, by contrast, the northeastern section produced only half of the country's PhD's, and the "Old South" produced 17 percent, while the Rocky Mountain states produced 5.4 percent. These figures contrast the earliest 5 years for which we have data available with the single most recent year available at this writing. To obtain somewhat more stable data, and still show the contrast over time, the figures for the third decade (1920–1929) have been contrasted with those of the early and middle 1960's (1960–1967)

in Table 11. These figures are portrayed graphically in Figures 8 and 9. These "distort maps" have been so drawn as to show state or regional size transmuted so that each state's area is shown proportional to the number of PhD's produced. The regional totals only are shown for the 1920's; the state-by-state detail is shown for the 1960's, for by this time each state had some PhD's. In the 1920's, 19 states had no PhD graduates at all, and 7 more produced 10 or fewer.

The District of Columbia appears as a "state" on this map because it is a high producer of PhD's (and a large "consumer" as well). The data for the District of Columbia are subsumed into the South Atlantic region and constitute a substantial portion of that region. In all the maps and tables, there-

TABLE 11

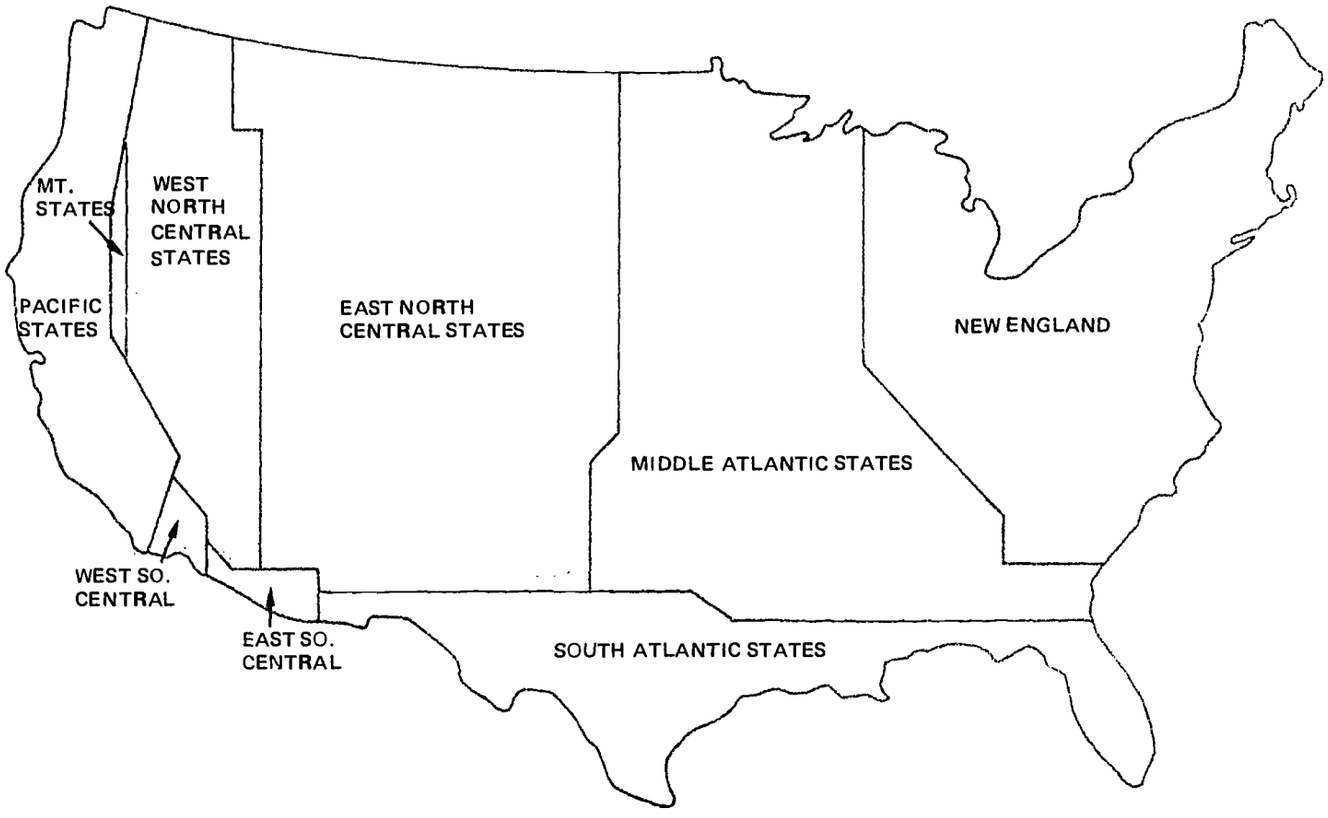
Doctorates Granted, by State and Region 1920-1929 and 1960-1967[a]

State or Region	Doctorates Granted 1920-1929 Number	Percent	1960-1967 Number	Percent
Maine	0	0.00	35	0.03
New Hampshire	1	0.01	130	0.12
Vermont	0	0.00	40	0.04
Massachusetts	1,188	9.97	7,785	7.04
Rhode Island	59	0.50	660	0.60
Connecticut	608	5.10	2,613	2.36
New England	1,856	15.57	11,263	10.18
New York	2,467	20.70	13,923	12.58
New Jersey	274	2.30	2,618	2.37
Pennsylvania	543	4.56	5,913	5.34
Mid-Atlantic	3,284	27.55	22,454	20.30
Ohio	364	3.05	4,238	3.83
Indiana	116	0.97	5,130	4.64
Illinois	1,761	14.77	8,030	7.26
Michigan	392	3.29	5,878	5.31
Wisconsin	754	6.33	3,803	3.44
East North Central	3,387	28.42	27,079	24.48
Minnesota	359	3.01	2,389	2.16
Iowa	505	4.24	3,003	2.71
Missouri	104	0.87	2,018	1.82
North Dakota	2	0.02	179	0.16
South Dakota	0	0.00	91	0.08
Nebraska	43	0.36	788	0.71
Kansas	47	0.39	1,201	1.08
West North Central	1,060	8.89	9,669	8.74
Delaware	0	0.00	278	0.25
Maryland	709	5.95	1,980	1.79
D.C.	381	3.20	1,860	1.68
Virginia	69	0.58	902	0.82
West Virginia	0	0.00	172	0.16
North Carolina	79	0.66	2,463	2.23
South Carolina	10	0.08	171	0.15
Georgia	0	0.00	873	0.79
Florida	0	0.00	1,944	1.76
South Atlantic	1,248	10.47	10,643	9.62
Kentucky	0	0.00	465	0.42
Tennessee	86	0.72	1,337	1.21
Alabama	0	0.00	564	0.51
Mississippi	0	0.00	309	0.28
East South Central	86	0.72	2,675	2.42
Arkansas	0	0.00	382	0.34
Louisiana	8	0.07	1,259	1.14
Oklahoma	1	0.01	1,579	1.43
Texas	46	0.38	3,628	3.28
West South Central	55	0.46	6,848	6.19
Montana	0	0.00	166	0.15
Idaho	0	0.00	66	0.06
Wyoming	0	0.00	224	0.20
Colorado	28	0.23	2,083	1.88
New Mexico	0	0.00	353	0.32
Arizona	3	0.02	795	0.72
Utah	0	0.00	979	0.88
Nevada	0	0.00	11	0.01
Mountain	31	0.26	4,677	4.23
Washington	64	0.54	1,886	1.70
Oregon	3	0.02	1,439	1.30
California	845	7.09	11,857	10.72
Alaska	0	0.00	20	0.02
Hawaii	0	0.00	118	0.11
Pacific	912	7.65	15,320	13.85
U.S. Total	**11,919**	**100.00**	**110,628**	**100.00**

[a]These data include PhD's of foreign baccalaureate origins.

FIGURE 8

The United States in proportion to 1920–1929 doctoral output. Each region is represented by an area proportionate to the PhD's granted in that area during the decade of the 1920's. The percentages are given in Table 11.

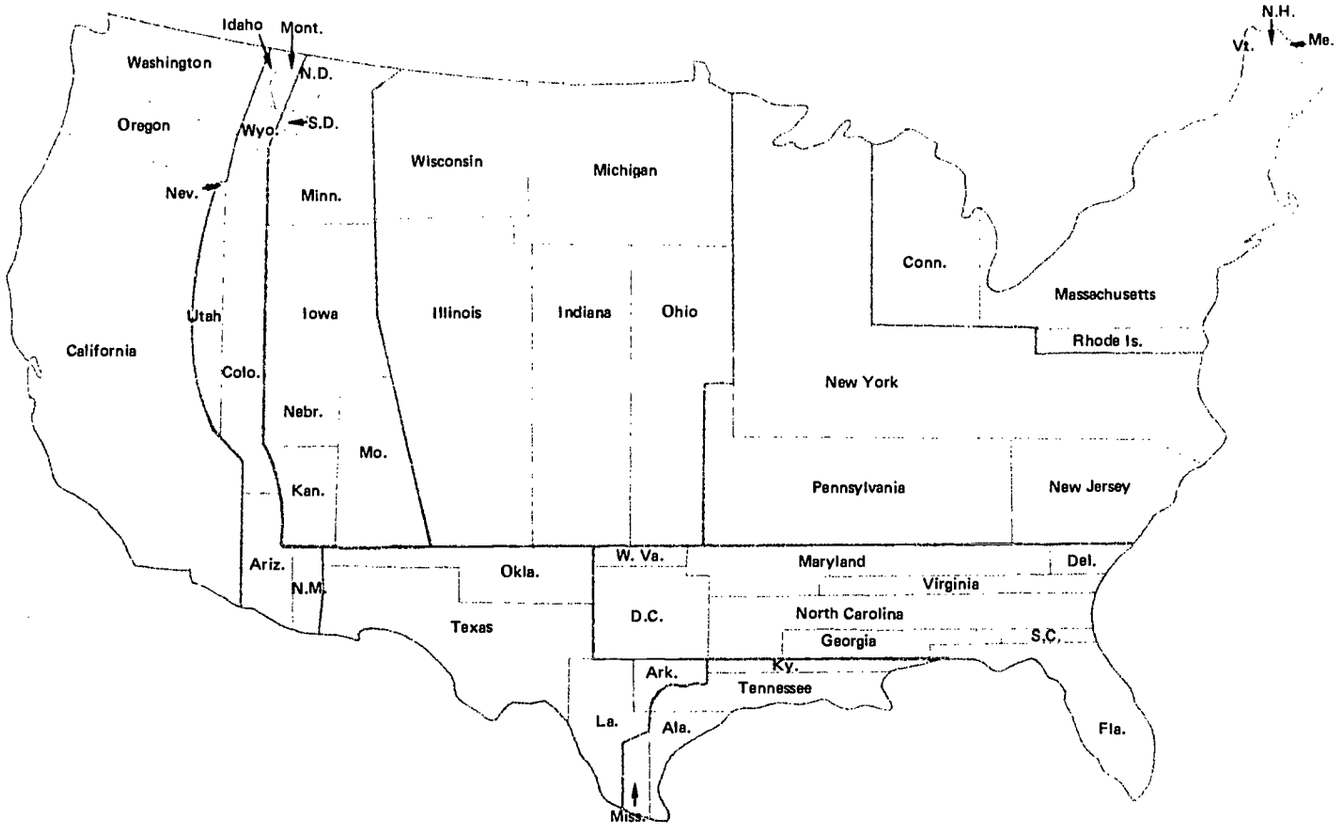


fore, D.C. will appear as a state, regardless of its political status. On the other hand, Alaska and Hawaii are omitted from most of the figures because it is infeasible to show their geographic relation to the conterminous states. In some of the statistical series to be reported later, Alaska and Hawaii are omitted simply because the requisite data were not available.

The states included in each of the regional groupings of Figure 8 are shown in Figure 9, in which the regional boundaries are more heavily marked. In the 1920's, when three fourths of all PhD's graduated in the northeast, the New England portion of the distort map extends nearly to the Mississippi River, and the Middle Atlantic states are almost crowded off the Atlantic Coast but extend clear to the Great Plains. The East North Central states of this distort map occupy the Great Plains and about half of the Rocky Mountain area, while the Rocky Mountain states are a mere sliver between the midwest and the coastal states. The South Central states are pushed to the far west, while the South Atlantic group stretches to the headwaters of the Rio Grande. By the 1960's, the states that were earlier almost or entirely nonexistent on the PhD map had appeared and had started to grow. The northeast, still dominant, had retreated somewhat, and an equalizing process could be observed.

FIGURE 9

The United States in proportion to 1960–1967 doctoral output. The areas of states and regions are proportional to the percentages of PhD's given in Table 11 for 1960–1967.



BACCALAUREATE VS. DOCTORATE ORIGINS

Table 11, which includes PhD's of foreign origin, gives the numerical data upon which these distort maps are based. To gain a better appreciation of the process of change over the decades, Table 12 shows the regional proportions of PhD's and of their U.S. baccalaureate origins (excluding other baccalaureates) by decade from 1920 to the 1960's. In Table 12, all PhD's of foreign origin have been excluded to avoid any distortions due to the differing regional distributions of PhD's of U.S. and of foreign origin. It provides data on the percentage of eventual PhD's granted in each region and the ratio of these two percentages as an index of the relative shift of a region between being a "baccalaureate origins producer" and a "PhD producer." Over this 47-year period, New England declined relatively from 15.5 percent of PhD's and 13.1 percent of BA origins of PhD's to 10.1 percent of PhD's and 10.2 percent of BA's. The Middle Atlantic states declined from 26.8 percent of PhD's to 20.2 percent but rose in BA origins from 19.6 to 21.8 percent. The East North Central states declined in both sets of percentages, while the West North Central states declined in the BA origins category and rose and then dropped again in PhD's. The South Atlantic states fluctuated up and down in both indices as some institutions rose and others declined over this period. Both East and West South Central states rose more or less steadily in both categories, as did also the Mountain and Pacific states. The changes in

TABLE 12

Regions as Baccalaureate Origins of PhD's and as Doctorate Grantors, by Decade, 1920 to 1960's,[a] and Ratios of BA Origins to PhD's

Region and Degree Level	Decade of Doctorate				
	1920-1929	1930-1939	1940-1949	1950-1959	1960-1967
New England					
BA	13.1	11.3	10.1	10.2	10.2
PhD	15.5	14.2	12.3	10.5	10.1
Ratio BA/PhD	0.85	0.80	0.82	0.97	1.01
Middle Atlantic					
BA	19.6	19.1	21.4	23.3	21.8
PhD	26.8	27.1	26.5	24.3	20.2
Ratio BA/PhD	0.73	0.70	0.81	0.96	1.08
East North Central					
BA	26.6	25.3	23.6	22.0	20.8
PhD	28.8	26.6	27.9	26.4	24.1
Ratio BA/PhD	0.92	0.95	0.85	0.83	0.86
West North Central					
BA	14.4	14.8	13.2	11.3	10.9
PhD	9.2	11.0	10.2	9.4	8.8
Ratio BA/PhD	1.57	1.35	1.29	1.20	1.24
South Atlantic					
BA	9.8	8.8	9.1	8.5	8.7
PhD	10.4	9.0	8.5	8.3	9.8
Ratio BA/PhD	0.94	0.98	1.07	1.02	0.89
East South Central					
BA	2.8	3.3	3.4	3.9	4.1
PhD	0.8	1.3	1.0	1.9	2.6
Ratio BA/PhD	3.50	2.54	3.40	2.05	1.58
West South Central					
BA	3.3	4.5	5.1	6.2	7.5
PhD	0.5	1.7	2.6	4.5	6.4
Ratio BA/PhD	6.60	2.65	1.96	1.38	1.17
Mountain					
BA	3.0	3.7	4.0	4.4	4.9
PhD	0.3	0.6	1.1	2.6	4.4
Ratio BA/PhD	10.0	6.17	3.64	1.69	1.11
Pacific					
BA	7.5	9.1	10.0	10.3	11.2
PhD	7.8	8.6	10.0	12.1	13.5
Ratio BA/PhD	0.96	1.06	1.00	0.85	0.83
U.S. Total					
BA	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
PhD	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[a]This includes U.S. baccalaureate origins only, excluding U.S. PhD's with foreign baccalaureates.

the West South Central and Mountain states have been most spectacular, as mentioned at the beginning of this chapter.

The ratios in Table 12 show the *relative* strength of a region as a PhD producer vs. its strength as a baccalaureate origin of PhD's. They do not measure the absolute strength of a region in either regard. They might best be regarded as an index of the balance of graduate/undergraduate development of the several regions. It is noteworthy that the range of differences in these indices, from highest to lowest across the nine regions, has gone steadily down

over the decades. There has been a strengthening of the regions originally very weak in PhD production. The figures on absolute numbers of PhD's, in Table 11, show that this leveling has not been at the expense of the regions originally strongest: All have grown together. It is *relative* growth rates that have evened up the ratios of Table 12, not a decline of the best schools or states.

Another way of looking at this change is to note the percentage of BA's who remain in their own regions for PhD's. Table 13 shows how this index has changed over the decades for each region. For the United States as a whole, about half of the PhD's attain their doctorates in the region of their BA's. This proportion has held approximately constant for about half a century. But this is a gross figure, concealing almost as much as it reveals. The regions that were highest in retention rates have declined somewhat, while those that were very low (down to 2 percent) have increased dramatically, so that now every region retains at least one third of its BA's through the PhD level. The largest change in retention rate is the West South Central region, which now retains 53 percent of its BA's as compared to 11 percent in the 1920's. The East South Central and Mountain states now both retain one third as compared to 14 percent for East South Central and 2 percent for the Mountain states in the 1920's. As institutions of higher education move from BA- or MA-granting to PhD-granting, the opportunities for doctoral education are seized upon by the nearby BA's. Thus, the need for distant travel for good graduate education decreases. Perhaps without this growth of opportunity in regions formerly without doctoral education facilities there might have been even more PhD migration; particularly because of the provision, during the past two decades, of fellowship and other support programs, it is easier for good students to move to the institutions of their choice—frequently prestigious schools in a distant state.

In spite of all of these changes, however, there remain tremendous concentrations of PhD output in small geographic areas, and one might well

TABLE 13

Regional Retention Rates, BA to PhD

Region	Percentage BA's Getting PhD's in Same Region, by Decade of Doctorate					Total All Decades
	1920's	1930's	1940's	1950's	1960's	
New England	50.9	54.5	49.0	44.2	41.0	**45.0**
Middle Atlantic	65.8	69.1	64.0	59.0	54.3	**58.8**
East North Central	60.9	60.9	61.7	60.5	58.4	**59.9**
West North Central	36.3	42.5	41.9	42.3	43.1	**42.2**
South Atlantic	51.1	46.5	44.6	40.4	46.9	**44.8**
East South Central	14.1	19.7	14.7	24.3	32.6	**26.2**
West South Central	10.9	26.6	33.5	44.6	52.9	**45.5**
Mountain	1.6	5.7	8.1	20.9	33.7	**23.4**
Pacific	52.7	55.8	56.9	62.0	59.4	**59.4**
U.S. Total	**50.7**	**52.3**	**51.0**	**50.8**	**50.5**	**50.8**

expect that the distortions evident in Figure 9 will be diminished in the foreseeable future, but not erased. One of the reasons for continued concentration of both baccalaureate and doctoral production is the relative density of population. The population density variations among the various states are well known, and they have their own historical and economic roots. It is useful in this connection to look at a similar distort map based on general population figures. The one shown in Figure 10 was produced by the Division of Research and Statistics, Ohio Bureau of Employment Services and is reproduced by permission. This map helps to put the distortions of the PhD maps into perspective. Here, too, the northeastern states and California dominate the map because of their population concentrations. The heaviest concentrations are along the seacoasts and the southern margins of the Great Lakes, with a few spots of relative density elsewhere. The locations of large universities tend to follow the general population concentrations. Perhaps to some extent they also tend to foster such concentrations, and it may be expected that with an increasing dependence of the economy on highly-trained manpower such a reciprocal effect might be more likely in the future.

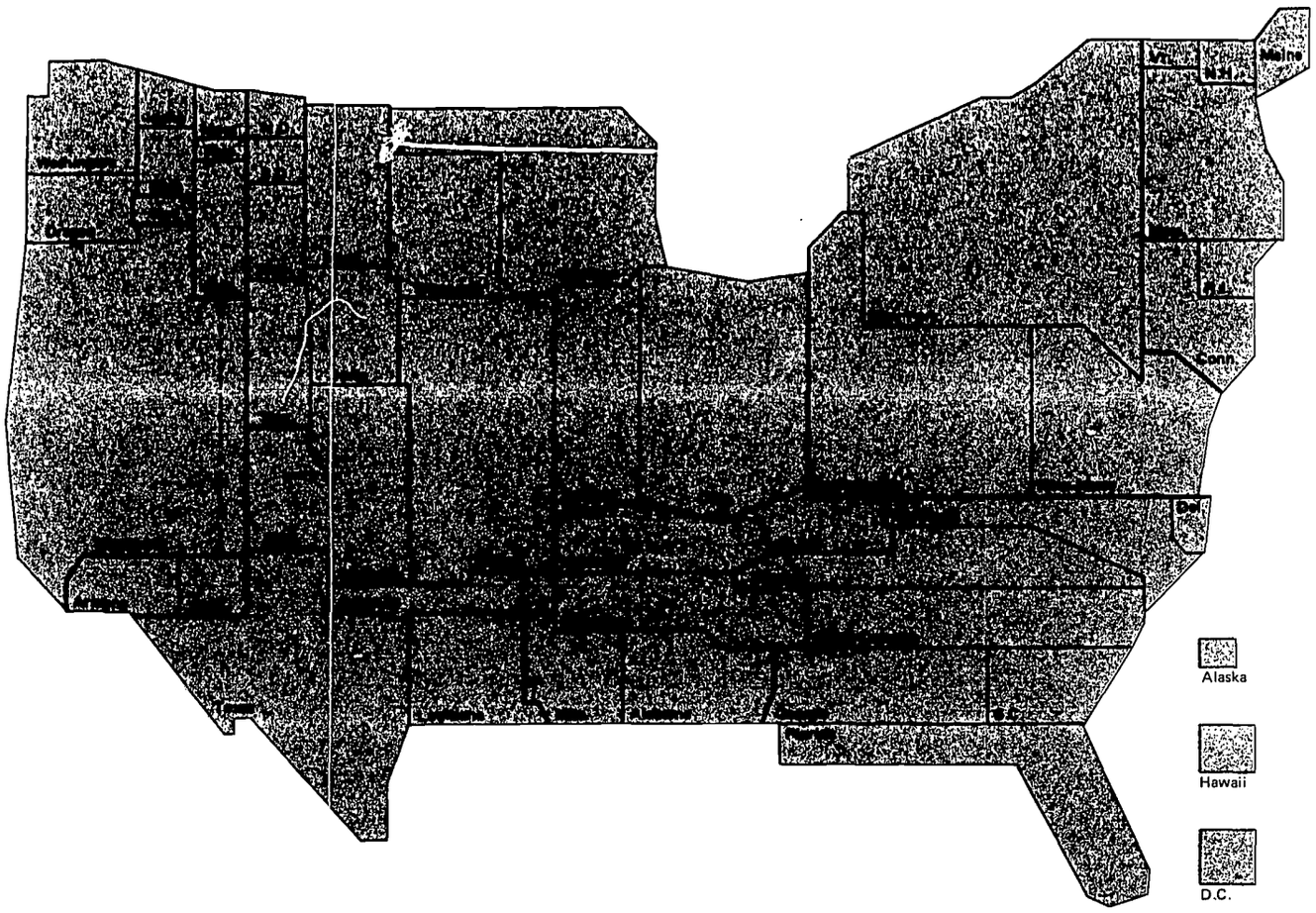
The location of all the 196 doctorate-producing universities (as of 1967) is depicted in Figure 11. Here, superimposed on a computer-produced map of the United States, each of these graduate schools appears as a separate dot. The locations on this map are approximate, as concentrations of institutions tend to crowd some schools out of position in a few instances. On this map, the "Northeast Corridor" from Boston to the District of Columbia shows up with dramatic force. The vertical line of universities through the center of the country marks the eastern margin of the Great Plains; from there to the Pacific Coast the population, both of universities and of people, in general, is sparse except for a few concentrations such as those around Denver and Salt Lake City. Appendix B uses this grid system to show the dramatic shifts from the 1920's to the 1960's of both baccalaureate and doctorate origins of PhD's.

THE STATES AS "PRODUCERS" AND "CONSUMERS" OF PhD's

PhD's are well-known for their migratory habits. In the early days, when only a few institutions offered PhD training, such migration was, of course, essential to obtain employment in other universities. This is still true today, but to a somewhat lesser extent. Universities offering PhD training are much more evenly distributed geographically than was true formerly. It is still the case, however, that some states are high producers of PhD's, and others relatively high "consumers" of PhD's, employing more than they graduate. For the various states to grow as PhD-producing sources, it is necessary that they import scholars and scientists from other areas to get started. As a state grows in doctorate output, its balance of "production" and "consumption" changes in the direction of greater equity. Over the past several decades, migration from high-producing to low-producing states has been observed, and is correlated with changes in relative doctorate productivity of the several states. Most notable has been a heavy movement from the Midwest to the South, as described in the first report in this series of Career Patterns studies. This migration has helped to build the southern schools to the point where they are now, in turn, sending their PhD's to all parts of the country. This movement is not yet as prominent, of course, as is the movement from the

FIGURE 10

United States in proportion to population, July 1, 1967. Base map computed by Division of Research and Statistics, Ohio Bureau of Employment Services, from Bureau of the Census estimates.

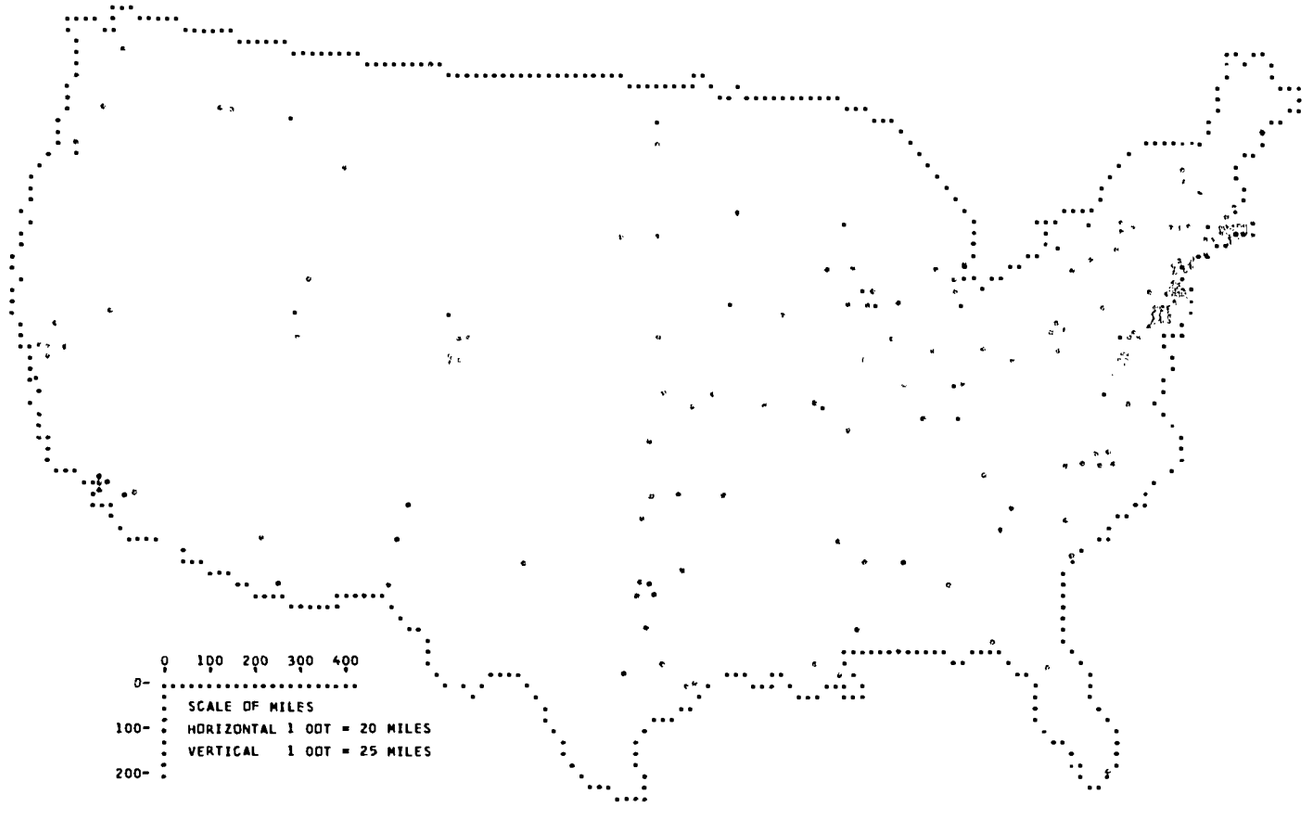


northeastern section, and (as will be shown later) a larger proportion of the southern PhD's tend to stay in the general region in which they obtained their training, either for academic or for nonacademic employment.

The disparity between a state's position as a producer and as a consumer of PhD's is shown in Figure 12, in which per capita production of PhD's is given on the horizontal axis and employment of PhD's is given on the vertical axis. The data for this figure are the 1957–1967 PhD's, by state of doctorate degree and state of expected first post-PhD employment. Those that did not have definite plans at the time of the doctorate have been pro-rated in this figure. Several groupings of states, as well as outstanding individual states, are apparent on this chart. Delaware, at the top of the chart, is a high "consumer" chiefly because of the employment of large numbers of PhD chemists in Wilmington. The District of Columbia is clear off the chart on both axes, as it is a relatively small, totally urban area with seven universities and with the United States government as an employer of PhD's. New Mexico is also high as an employing state, largely because of the governmental laboratories there. On a par with New Mexico as a per capita employer, but out-

FIGURE 11

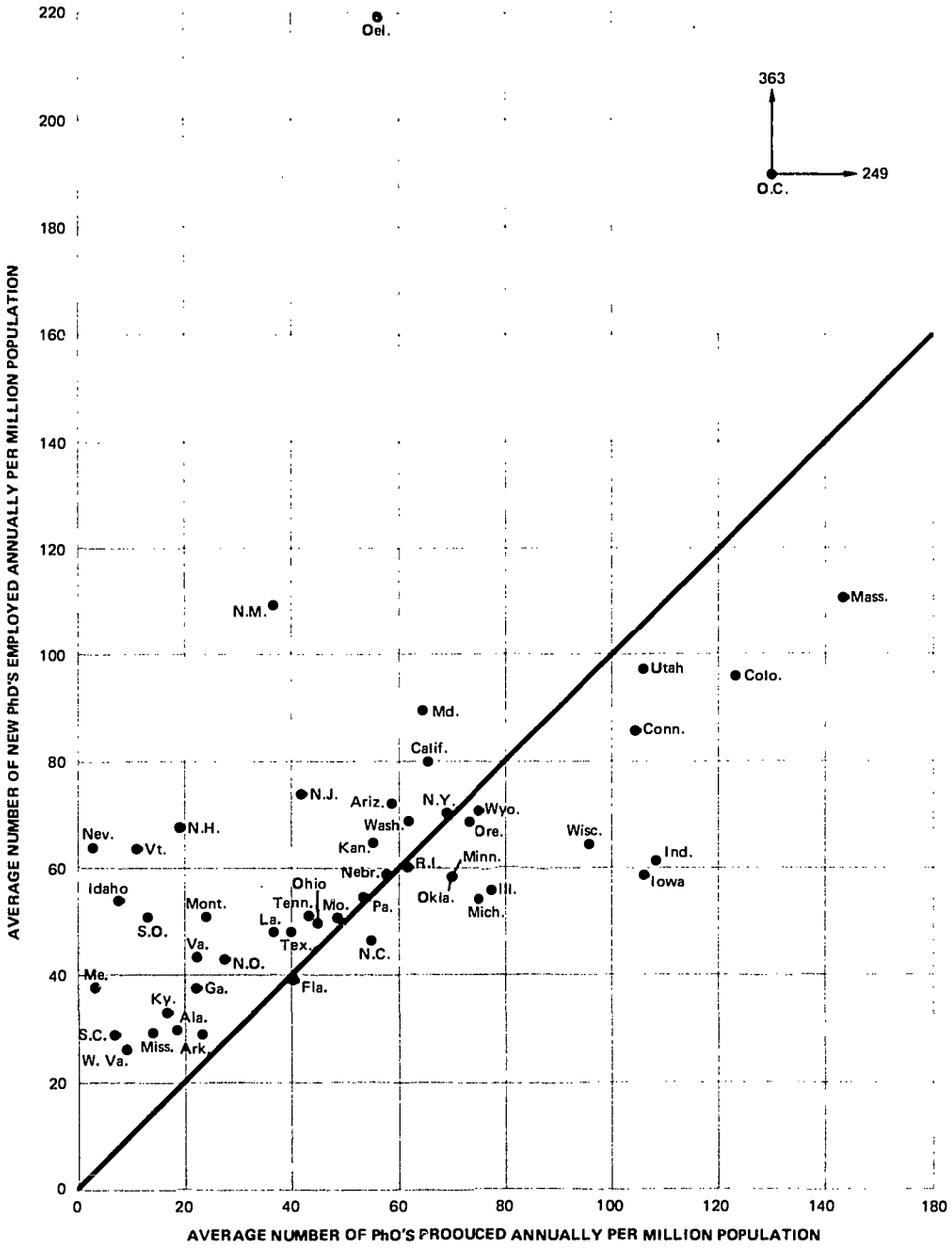
Location of doctorate-granting institutions, FY 1967.



standing as a producer, is Massachusetts with its renowned universities, making it a net producer rather than consumer. Also on the net producer side is Connecticut. Rhode Island is exactly at the center, producing and consuming equal numbers. The other New England states, with only minor productivity, stand as net employers, making New England exceptional in the range of the locations of its states on this chart. By contrast, the states of the Old South, with the exception of North Carolina, are grouped tightly near the bottom left portion of the chart; several Great Plains and Mountain states are right above them, i.e., still farther in the "net consumer" direction. A group of the larger midwestern states is prominent as net producers, with employment indices averaging about 60 and production indices ranging from 70 to 110. Kansas and Nebraska equal them in employment but have production indices below 60. Of the Mountain states, Utah and Colorado are outstanding in production, and along with Wyoming are "net producers," while the others, as mentioned before, are "net consumers." The Pacific Coast states are closely grouped in the 60–80 bracket on both indices. In the Middle Atlantic region, New York, at 70–70, and Pennsylvania, at 57–57, are in exact balance on both indices, while New Jersey is a net consumer as is neighbor-

FIGURE 12

State variations in doctorate production vs. first employment, 1957-1967. See Table 14 for numerical data.



ing Maryland in the South Atlantic region. Four states in four different geographic regions, but close together on the map, Missouri, Tennessee, North Carolina, and Ohio, are closely grouped in the 40-60 bracket on both indices.

STATE PROFILES FROM HIGH SCHOOL TO PhD EMPLOYMENT

Figure 12 refers only to PhD origin and first post-PhD employment. Yet each state may also be considered with regard to its status as a producer at the baccalaureate and even at the high school level. Indeed, this series of migration steps is of great importance, and the high school to college transition has been the subject of a good deal of study, notably recently by Gossman,

Nobbe, Patricelli, Schmid, and Stealr of the University of Washington in their 1968 book, *Migration of College and University Students in the United States.* From the Doctorate Records File of the Office of Scientific Personnel, it is possible to secure data on the migrations of a recent set of PhD-bound persons at each career point from high school to post-PhD employment. Using these data, and calculating indices similar to those of Figure 12 for each stage, a series of state profiles is derived showing the relative standing of each state at the high school, baccalaureate, doctorate, and employment stages. This set of profiles is presented in Figure 13, with an outline map of the United States superimposed to give a rough indication of the arrangement of the state profiles. Table 14 gives the basic data for these profiles.

In Table 14 and in Figure 13, the "PhD's per million population" figure is computed as follows: The average annual number of the PhD's of 1957–1967

TABLE 14

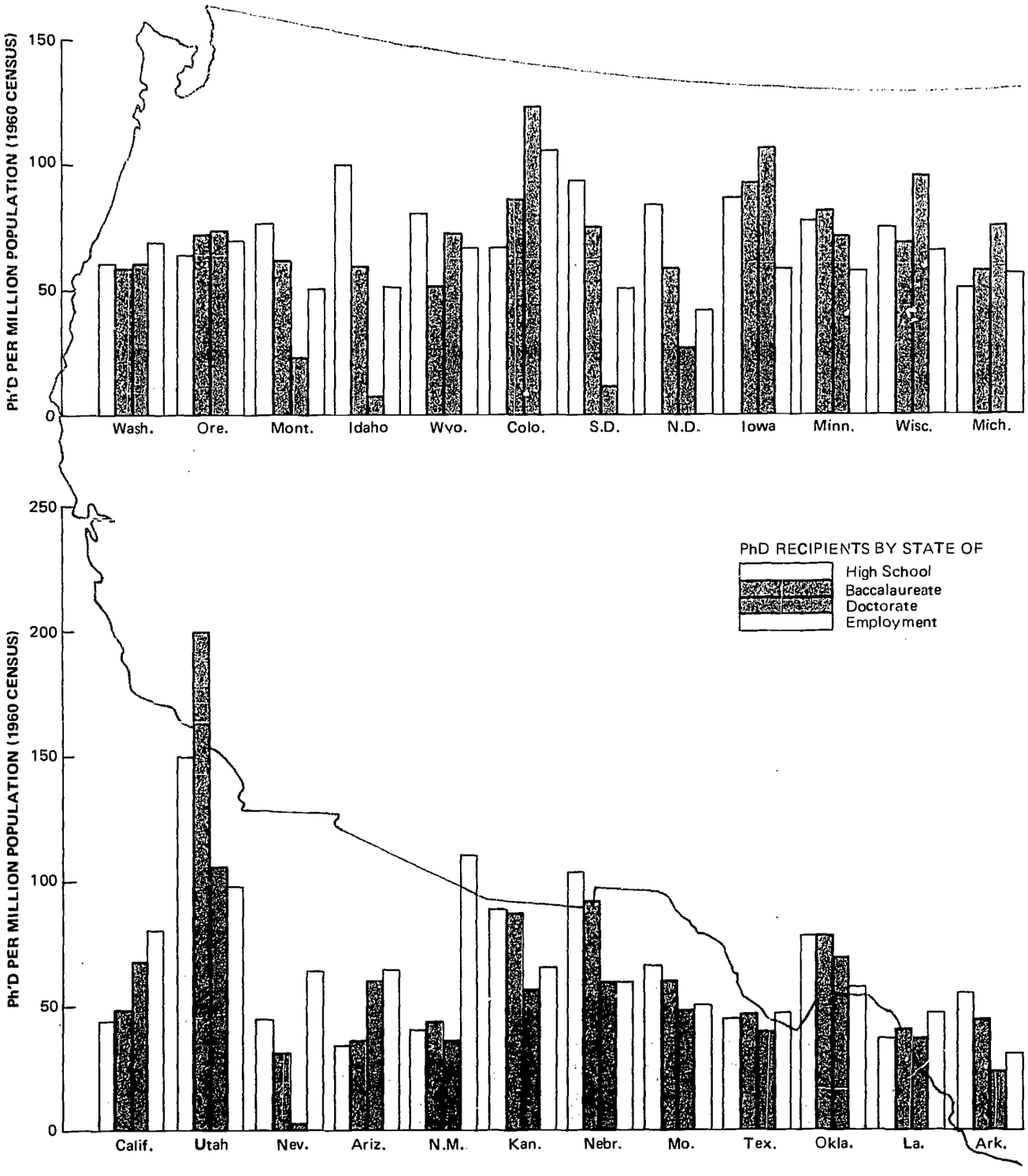
PhD's per Year[a] per Million 1960 Population, by PhD Recipient's State of High School, Baccalaureate, Doctorate, and First Employment

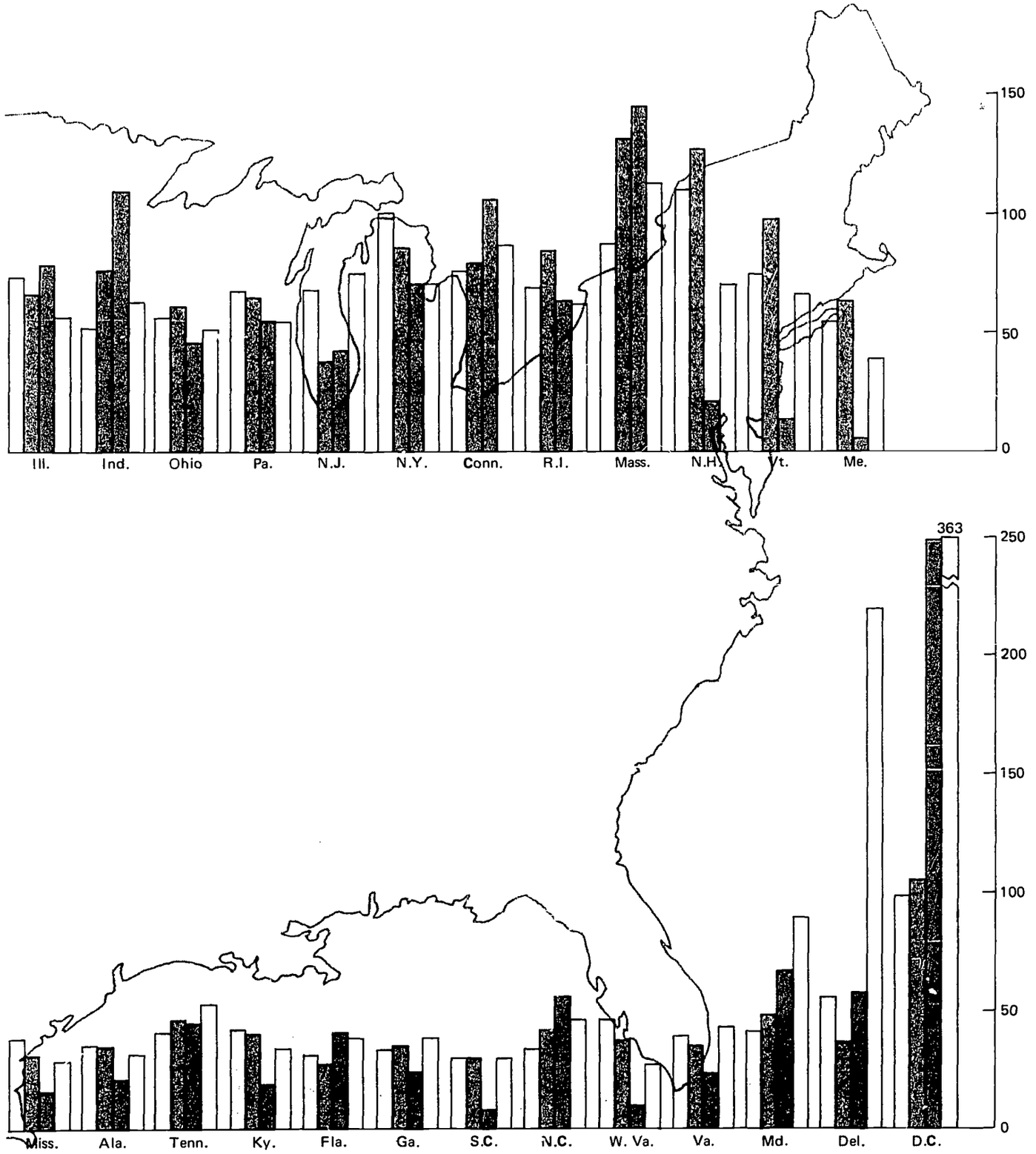
State or Region	PhD's per Million Population by Career Level			
	HS	BA	PhD	Job
Maine	53	61	3	38
New Hampshire	109	125	19	68
Vermont	73	97	11	64
Massachusetts	87	130	144	111
Rhode Island	66	84	62	60
Connecticut	75	78	105	86
New England	80	106	103	90
New York	100	85	70	70
New Jersey	66	38	42	74
Pennsylvania	66	64	54	54
Mid-Atlantic	83	70	59	65
Ohio	56	60	45	50
Indiana	58	76	109	62
Illinois	73	66	78	56
Michigan	51	57	75	55
Wisconsin	75	69	96	65
East North Central	62	64	74	56
Minnesota	78	82	70	58
Iowa	87	93	107	59
Missouri	66	61	49	50
North Dakota	85	59	28	43
South Dakota	94	76	13	51
Nebraska	103	92	59	59
Kansas	90	89	56	65
West North Central	81	79	65	56
Delaware	55	36	57	220
Maryland	42	48	65	90
D.C.	97	108	249	363
Virginia	39	35	23	43
West Virginia	46	38	9	26
North Carolina	32	41	55	46
South Carolina	29	29	7	29
Georgia	32	33	22	38
Florida	30	26	40	39
South Atlantic	37	37	41	57
Kentucky	41	40	17	33
Tennessee	40	45	44	51
Alabama	35	35	19	30
Mississippi	33	30	14	29
East South Central	38	38	25	37
Arkansas	54	45	23	29
Louisiana	37	40	37	48
Oklahoma	78	78	70	58
Texas	45	46	40	48
West South Central	49	49	42	47
Montana	78	63	24	51
Idaho	100	61	8	54
Wyoming	82	53	74	69
Colorado	69	88	124	106
New Mexico	40	43	37	110
Arizona	35	37	59	72
Utah	150	200	106	98
Nevada	45	32	3	64
Mountain	72	77	69	85
Washington	62	61	62	69
Oregon	65	74	75	71
California	44	48	66	80
Pacific	48	52	67	77

[a]Average for 1957–1967 period.

FIGURE 13

PhD's per year per million 1960 population by PhD recipient's state of high school, baccalaureate, doctorate, and first employment. (Data from Table 14.)




150
100
50
0
Ill.
Ind.
Ohio
Pa.
N.J.
N.Y.
Conn.
R.I.
Mass.
N.H.
Vt.
Me.
363
250
200
150
100
50
0
Miss.
Ala.
Tenn.
Ky.
Fla.
Ga.
S.C.
N.C.
W. Va.
Va.
Md.
Del.
D.C.

(the longest period for which data were available), who had their high school education in a given state, was divided by that state's 1960 population (expressed in millions). This gave a high school origins index. Similarly, the number who had their baccalaureate origins was divided by the 1960 population, for the baccalaureate origins index. Similar calculations were made for the number of doctorates granted and new PhD's employed in each state, always using the average annual data for 1957–1967 for the PhD's and the 1960 population of the state as a divisor. The data were then accumulated by census regions as shown in Table 14. Thus, New England had an annual average of 80 people graduate from its high schools and later take a doctorate anywhere in the United States, for every million of its population. Because of its good system of higher education, more eventual PhD's came to New England for baccalaureates and doctorates (over 100 per year for each million of New England's population). Each year over the 1957–1967 period it employed 90 new PhD's per million general population. The same kind of interpretation applies to each state and region in Table 14; in Figure 13 these four indices are shown graphically.

At the far left, upper row, Washington and Oregon appear as approximately balanced at all four stages. Next to Oregon are Montana and Idaho, both doing quite well at the high school stage, but with very low indices at the PhD-production stage, as is true also of the Dakotas. Colorado, among the Mountain states, contrasts in being high as a PhD source, as are Iowa, Wisconsin, Michigan, and Indiana in the Midwest group. Coming farther east along the northern tier, New Jersey is notable for its low indices at both the BA and PhD stages, while New York is high at the high school level, somewhat lower at the BA level, and approximately in balance at the PhD and employment levels. Connecticut and Massachusetts, as noted in Figure 12, are outstanding as PhD sources, while the remaining New England states, although doing creditably at the high school and college levels, are low at the doctorate level. Going back to the west end of the chart, along the lower tier, California is surprising in that its high school and college indices are as low as they are. California differs from most states in that each succeeding stage is higher than the one before—a characteristic one might well expect of a growing, technologically oriented state. Utah is outstanding, as it has been for years, at all educational levels, whereas Nevada, Arizona, and New Mexico are outstanding as places of employment rather than origin. Kansas and Nebraska do well at the high school and undergraduate stages, whereas Missouri, Texas, Oklahoma, and Louisiana are in fairly near balance at all stages, as is Tennessee farther to the east. Arkansas, Mississippi, Alabama, Kentucky, Georgia, Virginia, and West Virginia, as noted earlier in connection with Figure 12, are particularly low at the PhD-production stage, and all of this group are below the national average at all four stages. Maryland, with a profile very like that of California, and North Carolina, not far behind, indicate the direction of growth and change that might well be expected of this southeastern group of states over the next few decades.

CHAPTER III A COMPUTERIZED DISTANCE/DIRECTION, ORIGIN/DESTINATION METRIC

The picture up to this point has concerned sources of PhD's and their eventual employment, with the net effects of migration portrayed on a state-by-state basis. To some extent, the actual migration of PhD's is masked by these data. When two people move in such a fashion as to cancel out each other's movements, it does not show in the data portrayed so far. Is it important? It could be argued that such direct exchanges have no important economic or educational impact, insofar as the states are concerned, regardless of their importance to the individuals. It often happens, however, that the statistics that are gathered regarding movement show movement in one direction and not the other. A university may have data on where its faculty came from, but may not have data on where former staff members went to when they left. Any given state is likely to have much more complete and accurate data regarding the home states of its undergraduate students than data that show where its own high school students have gone to college. This is a natural and almost inevitable result of the relative difficulty of data collection. On the one hand there is a clearly-defined "captive" group to survey; on the other, a diffuse and dispersed group that may not be accessible or responsive. Many fact-gathering efforts are plagued with unwanted bias in measuring the movement in opposite directions. Conclusions based on such biased data may be entirely in error, and action taken on such conclusions may have the opposite of the intended effect. It becomes important, therefore, to have a general nation-wide system for measuring mobility that will show with equal accuracy each movement from point to point. It has been the aim of this study to achieve and exploit such a system of migration analysis.

BRAINS AND DOLLARS: CHICKEN AND EGG?

Concern over mobility has become widespread as has awareness that some regions with excellent educational institutions are not holding their PhD graduates and that the "Route 128 Phenomenon" has developed. The Route 128 Phenomenon refers to the development along Route 128 outside of Boston of a large number of technologically oriented industries that draw heavily on the brainpower of Boston's universities. Every state would like to have such stimulation to the economic and intellectual life of its communi-

ties, but only the more spectacular examples of such developments have received attention. The fact that such growth is a magnet for the brainpower of the whole nation has aroused concern in those areas that have been high producers but relatively low consumers of technological talent. What are the facts? What basis is there for rational policy determination? It is quite apparent on examination that the problem is one of considerable complexity and that simplistic solutions are likely to be wide of the mark. In such a situation it is wise to step back and survey, insofar as is possible at this point, the whole complex of issues and problems and the facts that have been gathered previously.

NATIONAL VS STATE VIEW

The national picture as a whole is, perhaps paradoxically, the easier one to analyze. When local variations are ignored, the enormous advantages of migration to the whole country are easy to observe. Free trade in brainpower helps to develop resources that are of nation-wide importance. When a state that has had very little in the way of PhD-producing resources mounts an effective program, it releases energies, intellectual and economic, that have been bound heretofore by lack of opportunity. Furthermore, such a process of equalization is in accord with our national ideal of equal opportunity. The talent of young people of all the states should have equal opportunity to develop, but it is simply not possible for this to happen when wide geographic variations exist in educational facilities. National programs of fellowships and traineeships may help, but they cannot function effectively if the places where such fellowships may be held are geographically restricted. It is in the national interest, therefore, for an evening-up of the opportunities to take place. If one state produces more PhD's than it employs, then it is providing an opportunity for its own citizens, and the fact that they go elsewhere to work is, from the national standpoint, beneficial when their employment opens up greater opportunities for some less-developed state. It is in this sense that the national picture is simpler than the state-level picture.

At the state level, it makes a difference to those concerned, for example, with taxation, if a state's taxes go to support an educational effort that is seen to be a national benefit but to have minimal local benefit. What are the local benefits? They may be less visible, less tangible, more diffuse than the quite obvious provision of appropriations from a legislature for a state university. It may appear to policy-makers and legislators that the action they take to provide opportunity for their own citizens is, instead, benefiting citizens of other states, many of whom do not remain to employ their skills to the economic benefit of the state in which they have obtained their education. The immediate reaction to this perception is likely to be one of drawing back, or retrenching, imposing higher fees and tuition on out-of-state students, or both of these types of action simultaneously. Such a reaction, quite understandable on a local level, may be detrimental to the nation as a whole, and perhaps in its final results, detrimental to the state itself. In the absence of quantitative information on both the short-term and long-term effects of state support of higher education and, in particular, graduate education, it may be unwise to retrench. However, it is likely to happen when legislatures are faced with rising costs and insufficient resources. An action that appears, in the short term at least, to be in the interest of an individual state may be seriously detrimental to the nation as a whole, and, if all states take similar

action, all states will lose. The national benefits of free trade in brains—benefits that are easy to observe at the national level—will be lost to each state individually as well.

MIGRATION OF HIGH LEVEL PERSONNEL

This brings us back again to the matter of the facts of movement. What have been the movements of PhD's, and what have been the correlates of such movements? Can any clear relationship be established between the excellence of a state's educational system and the migration of students, or between the quality of the education available in a state and the economic prosperity of the state? To answer these questions requires the development of a system of measuring migration in quantitative terms, and of state indices of educational excellence and economic development. Those tasks have been central to the development of this report. But first, a brief review of some of the other research that has been done in this area may be of value.

In 1960, Berelson[1] described the shift in doctorate output from a small number of leading institutions to a larger number of less prestigious ones, with a wider geographic spread. More recently, interregional migration of American scientists for education and employment has been studied by Alan E. Bayer.[2] He found that migration induces a general tendency toward equalization of regions, both qualitatively and quantitatively, but that migration alone is not sufficient to erase regional variations. He finds that some regions gain qualitatively while losing quantitatively, while others may gain or lose both quantitatively and qualitatively. His measure of quality was that of the Cartter ratings of the graduate departments[3] and, thus, referred to quality of education received rather than individual capacity. Bayer finds mobility positively correlated with quality, i.e., that those educated in the higher-rated departments are more likely to move both prior to and subsequent to the PhD. Those who never leave their regions of high school receive, on the average, the poorest graduate education. People travel across regions to obtain high-quality training and, subsequently, are more likely to move again for employment in that they are in greatest demand on the national professional labor market. Those who are educated at the lesser-rated institutions tend to move in more restricted state or regional labor markets.

The Stanford Research Institute (SRI) has made studies[4] of the migration of engineering and technical personnel in the aerospace industry and has found, for example, that their migrations follow very faithfully the general migration streams of the population as a whole. Their studies, carried out in several strategic locations, have important general conclusions for the recruitment and retention of technical personnel in developing industries, but do not attempt to assess the impact of such movement on a nation-wide state-by-state basis. What they do show is that a careful assessment of the facts with regard to migration streams may lead to a great reduction in "turbu-

[1] Bernard Berelson, *Graduate Education in the United States* (New York: McGraw-Hill, 1960).

[2] Alan E. Bayer, *Interregional Migration and the Education of American Scientists*, Sociology of Education 41, No. 1 (Winter, 1968).

[3] Allan M. Cartter, *An Assessment of Quality in Graduate Education* (Washington, D.C.: American Council on Education, 1966).

[4] A. Shapero, R. P. Howell, and J. R. Tombaugh, *The Structure and Dynamics of the Defense R&D Industry* (Menlo Park, California: Stanford Research Institute, 1965).

lence" in personnel movement—people moving in and out, seeking, but not readily finding, a place where they can settle down for a sufficient time to be maximally productive. The SRI studies also suggest that an intelligent match of the incentives offered for migration to the pre-existing motivational system of the people who move can pay off both for the employer and employee. Applied at a state level, this suggests that a careful assessment be made of the conditions in a state that may serve as an incentive to immigrate or to remain in a particular location, as opposed to negative conditions that may lead to emigration. The paucity of facts regarding these aspects of the social structure and dynamics of a state, as they impact on high-level personnel, is, perhaps, the most outstanding aspect of this whole situation.

NEEDED: A MIGRATION METRIC, COMPUTERIZED

The need for a quantitative system of dealing with internal migration, as compared to one that deals only with interstate or interregional movement, is readily dramatized by some examples of the minor movements that flaw interpretations based solely on state and regional data. One may move, for example, from Bridgeport, Ohio (in the East North Central region) through Wheeling, West Virginia (in the South Atlantic region) into Washington, Pennsylvania (in the Middle Atlantic region) in less than an hour's drive. In fact, commuting this distance would be possible, even though it might not be a frequent phenomenon for PhD's. Another example, better known, is movement from Connecticut, in the New England region, into New York, in the Middle Atlantic region. This is done regularly by large numbers of commuters, many of them PhD's. Thus, state or region of residence and state of employment may be quite different, and movement of residence may or may not be associated with the impact of the effect of a person's work on the economic community. Such examples as these are, of course, the exception rather than the rule in analysis of state data, but they are by no means isolated, as the example of Washington, D.C. would testify. Here, as in New York, one commuting area includes three states (the District of Columbia classifies as a state in these statistics). Variation in state size from Rhode Island to Texas or Alaska makes movement across state lines a rather imperfect index of migration, from the standpoint of quantitative measurement. It remains true, however, that state data cannot be abandoned, as states are the political units that make most of the decisions affecting graduate education, and state policies may have enormous effects on economic developments. The need is for a system that blends with and yet transcends state boundaries.

To provide a quantitative index of migration, a computerized map of the United States was prepared. On this map, a rectangular grid was laid out and each institution of higher education was located on this grid in terms of north–south and east–west axes. These locations were made accurate to within 10 miles in terms of the grid system. The system itself has a certain amount of distortion of direction (but not of distance) simply because of the curvature of the earth. The map assumes a flat surface. For an area the size of the United States, this directional distortion is noticeable on the coasts, but near zero in the central part of the country. For the purposes of this analysis, the directional distortions were deemed relatively unimportant, as directions were computed only to the extent of eight direction vectors: north, northeast, east, southeast, south, southwest, west, and northwest.

These vectors give sufficient detail to describe the movements concerned, and the minor distortion of direction induced by superimposing a rectangular grid on a curved surface does not result in erroneous interpretations. Appendix A gives a fuller description of the system and the reasons for choosing it over the possible but much more complex system of latitude and longitude, with its continual requirement for employment of spherical trigonometry. Figure 11 employed this computerized map to spot the locations of the PhD-producing universities. Figure 14 shows state "centers of population" on the standard map of the United States and Figure 15 on the computer-produced map. It is these state population centers that have been used to describe location when only the state of residence is known. A center of population is that point to which all the people in a state would assemble to minimize the total movement. This concept is useful at both state and national levels and will be employed a number of times in this report.

By means of this grid location system, an individual's movement may be charted in miles and in direction from any career stage to any other stage. As one goes from high school to college to graduate school and on to employment after the doctorate, each move can be computed as to direction and distance if the locations at each point are known. These movements can then be summed and averaged for groups of individuals in terms of their original locations, their locations at intermediate points, or their final destinations.

FIGURE 14

State centers of population.

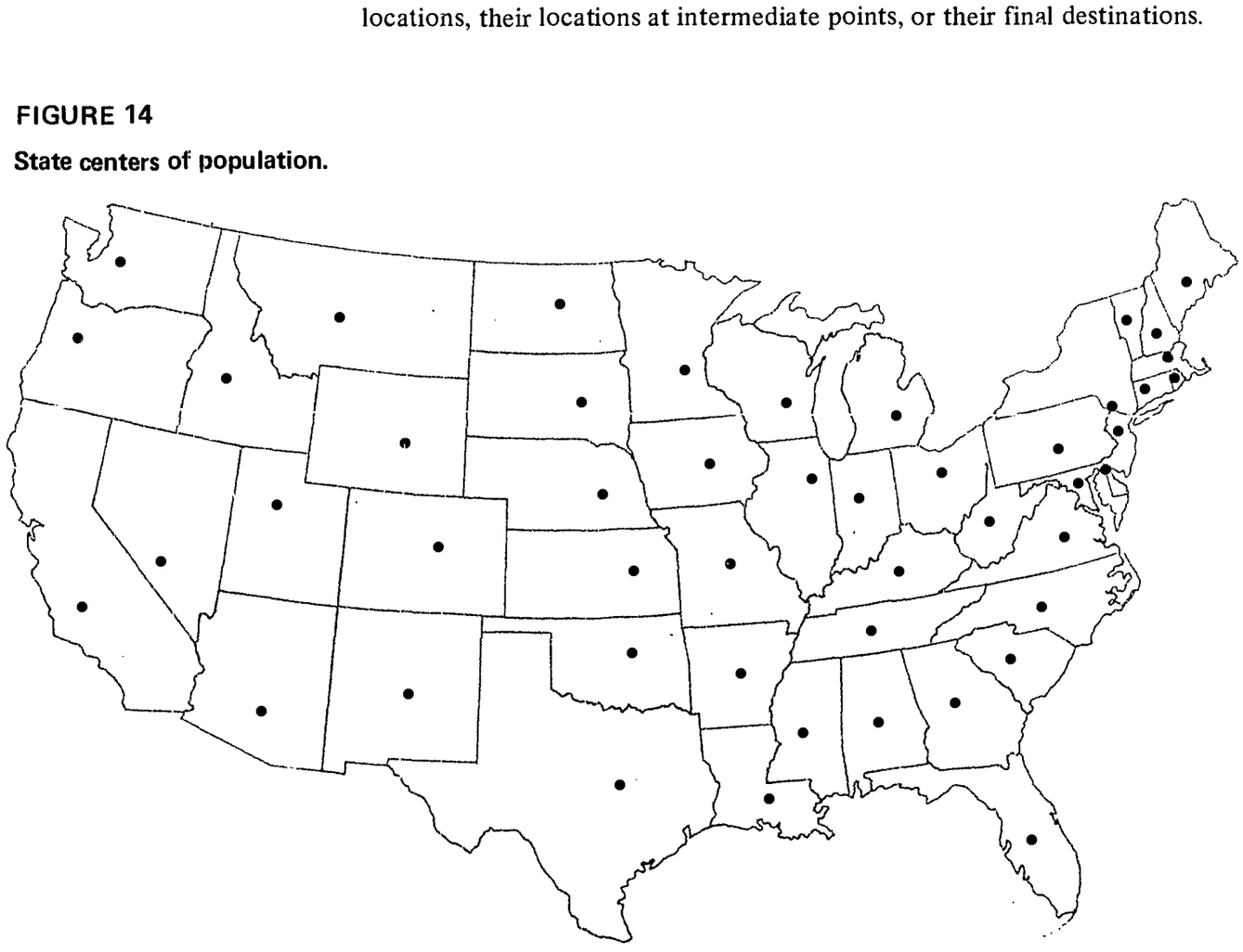
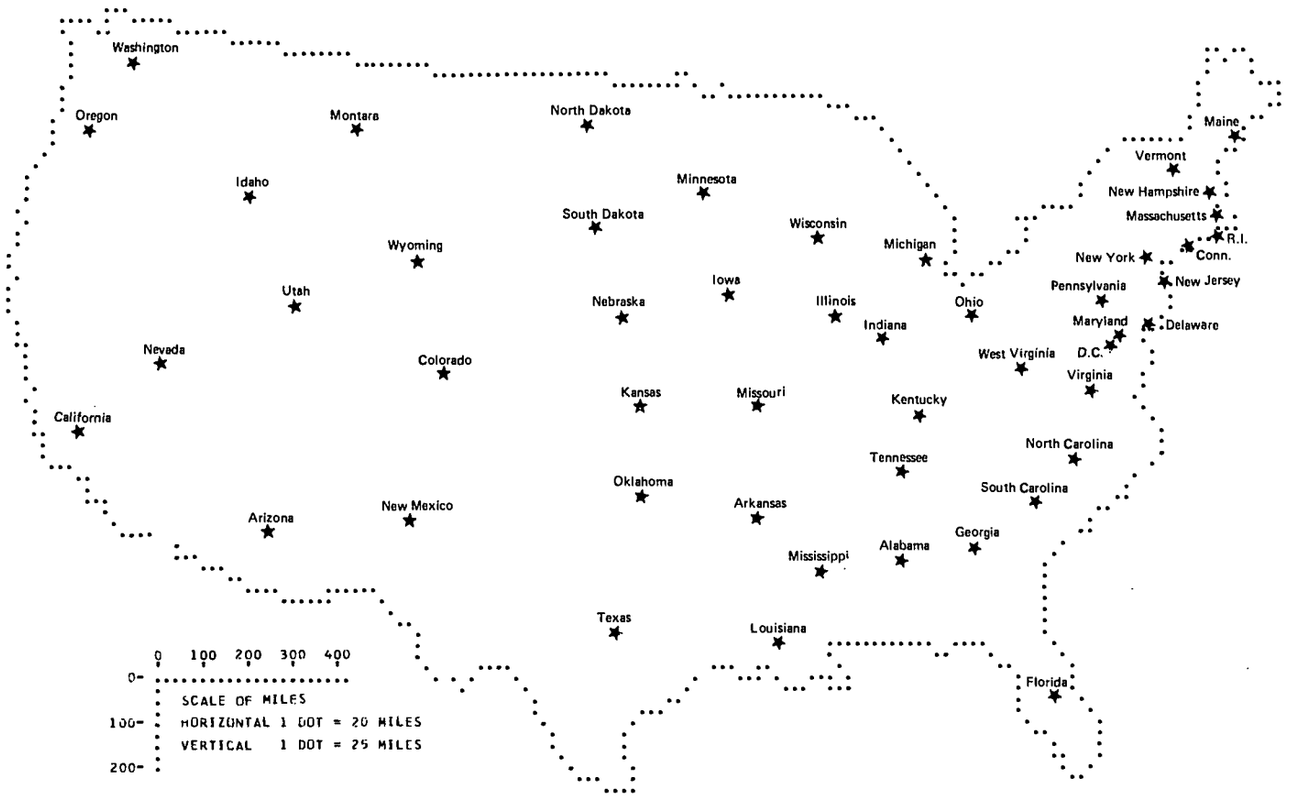


FIGURE 15

Computer-produced map of the United States showing state centers of population.



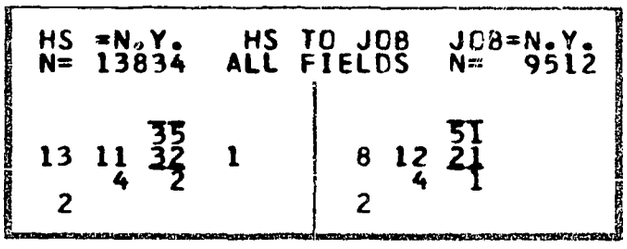
Although these computations would be an impossibly laborious human task, they are readily made on the computer. Thus, the number of people who move in any direction for any given distance between any two career stages can be determined. The total of such movements can then be displayed by appropriate diagrams that the computer can also readily produce.

Such a set of diagrams is shown in Figure 16, which shows distance and direction of movement. Distances are shown only in three steps. The lesser step beyond the boundaries of a state of origin (or destination) is 300 miles. This distance, chosen somewhat arbitrarily, is taken to represent a fairly easy 1-day's drive from home, and is designated zone A. Beyond 300 miles, but under 1,000 miles is the second step; more than 1,000 miles is the third step. These distances were chosen for convenience; other intervals might equally well be used, with results differing in detail but probably not in general effect. (See Appendix C for details.)

For each state, the four stages of movement that are of maximum importance for the study of PhD migration are shown. (Omitted are the two other possibilities: high school to college and college to postdoctoral employment.) The first pair of diagrams (upper left) shows movement from high school to PhD institution. The left member of this pair shows the dispersion of the state's high school graduates to their institutions of PhD. The right member

of the pair shows the in migration to the same state for doctoral education. Moving along the row, the next pair of diagrams shows the same state with respect to the baccalaureate-to-PhD movement, again as a state of BA origin and PhD destination. The third pair of diagrams shows the movement from state of doctorate to state of first post-PhD employment, with the state as producer (left) and consumer (right) of PhD's. The final pair of diagrams shows the beginning and ending stages of this series of migrations—the whole movement from high school origins to post-PhD employment. Each row of diagrams thus depicts a series of transitions and the state's output and intake at each of the chosen transitions. In each of the diagrams, the number of eventual PhD's, who have the given state as a point of origin or as a point of destination, are given immediately below the state name. The figures in the diagram proper, showing zones and directions of movement, are percentages, based on the number given immediately above.

To better define the meanings of the numbers and percentages in each diagram, the data for New York, in the lower right corner of the first page of Figure 16, are reproduced below for the pair of diagrams depicting the high school to post-PhD employment.



In the left diagram, the number 13,834 indicates that 13,834 PhD's of 1957–1967 had their high school origins in New York. At the center, the figure 35 indicates that 35 percent of these found post-PhD employment in New York. The figure 32 directly below indicates that 32 percent were employed outside of the state of New York but within 300 miles of their high school of origin. This is referred to as Zone A. The figure 2 directly below indicates that 2 percent of the 13,834 found post-PhD employment within 1,000 miles south of their high schools of origin, but outside Zone A. The figure 4, on the lower left diagonal, indicates that 4 percent were eventually employed outside Zone A but within 1,000 miles in a southwesterly direction from their high schools. The 2, farther out on this diagonal path, shows that 2 percent were employed more than 1,000 miles southwest of their high schools. Similarly, the 11 and 13 indicate a migration westward of 11 percent up to 1,000 miles but outside Zone A, and 13 percent over 1,000 miles. None moved northwest or north beyond Zone A, because it would scarcely be possible and still remain within the territorial limits of the United States. Such movement northeastward is possible, but did not occur, at least not enough to amount to 1 percent of the 13,834 cases. One percent moved eastward (probably to the Boston area) and none southeastward, as that would be into the Atlantic Ocean.

In the right-hand diagram, the 9,512 indicates that 9,512 PhD's of 1957–

1967 found post-PhD employment in New York State. (This is a minimal number; some who did not have definite plans when their questionnaires were completed no doubt also moved to New York.) Of the 9,512, 51 percent had their high school origins in New York (51 percent of 9,512 = 35 percent of 13,834) and 21 percent within 300 miles of their high schools, which were *outside* of New York (i.e., Zone A refers to origin, not destination). Similarly, 1 percent came from the south, 2 percent from over 1,000 miles southwest, 4 percent from under 1,000 miles southwest, and so on.

A somewhat more detailed picture, giving a finer breakdown of distances traveled in each direction, is afforded in Appendix C, which also shows movements in terms of percentages as well as raw numbers.

STATE-TO-STATE MIGRATION

Some people acquire information more readily from a table than from a diagram. For that reason, a certain redundancy is advantageous and is provided by the somewhat different view of migration through the various stages from high school to post-PhD employment shown in Appendix D. Here, the migration from and to each state from each other state is depicted on a percentage basis. All six possible migration stages are shown: high school to college, to PhD institution, and to post-PhD employment; baccalaureate school to PhD school and eventual job; and PhD to job. Two sets of percentages are given, one for each state of the pair as origin, and the other member of the pair as destination. This table may be used in conjunction with the vector diagrams of Figure 16, to indicate just which states are involved in any of the migration paths shown.

FIGURE 16

Number of eventual PhD's moving from each state and to each state at four career transitions, and percentages remaining in the state; percentages moving outside the state but within 300 miles of origin; and percentages moving in each direction, up to 1,000 miles and over 1,000 miles.

Move from High School to PhD with Reference State as Origin	Destination	Move from Baccalaureate to PhD with Reference State as Origin	Destination	Move from PhD to Employment with Reference State as Origin	Destination	Move from High School to Employment with Reference State as Origin	Destination
HS =ME. N= 505	HS TO PHD ALL FIELDS	PHD=ME. N= 27	BA =ME. N= 583	BA TO PHD ALL FIELDS	PHD=ME. N= 27	PHD=ME. N= 25	PHD TO JOB ALL FIELDS	JOB=ME. N= 288	HS =ME. N= 401	HS TO JOB ALL FIELDS	JOB=ME. N= 288
13 9 2 36 33 6 1	4 30 52 15		12 6 1 35 38 7	7 30 44 19		56 24 12 8	11 8 2 29 45 5		9 4 14 32 30 7 1 2	10 5 20 22 36 5 1	
HS =N.H. N= 653	HS TO PHD ALL FIELDS	PHD=N.H. N= 113	BA =N.H. N= 751	BA TO PHD ALL FIELDS	PHD=N.H. N= 113	PHD=N.H. N= 94	PHD TO JOB ALL FIELDS	JOB=N.H. N= 325	HS =N.H. N= 525	HS TO JOB ALL FIELDS	JOB=N.H. N= 325
11 11 2 52 21 2	4 4 11 65 12 4		14 13 2 47 18 2	4 5 11 68 8 4		10 7 3 31 34 9 1	15 14 2 48 18 2 1		15 8 6 42 23 3 1	14 12 10 44 15 2 1	
HS =VT. N= 277	HS TO PHD ALL FIELDS	PHD=VT. N= 41	BA =VT. N= 368	BA TO PHD ALL FIELDS	PHD=VT. N= 41	PHD=VT. N= 35	PHD TO JOB ALL FIELDS	JOB=VT. N= 195	HS =VT. N= 222	HS TO JOB ALL FIELDS	JOB=VT. N= 195
11 11 2 49 18 4 3 2	5 2 12 61 15 2 2		7 6 3 51 20 5 8 1	5 2 24 44 15 7 2		11 6 14 14 43 9 3	7 7 3 57 12 6 8 1		11 7 8 44 16 5 1	6 7 9 57 12 5 1	
HS =MASS N= 4450	HS TO PHD ALL FIELDS	PHD=MASS N= 7399	BA =MASS N= 6657	BA TO PHD ALL FIELDS	PHD=MASS N= 7390	PHD=MASS N= 5916	PHD TO JOB ALL FIELDS	JOB=MASS N= 4591	HS =MASS N= 3533	HS TO JOB ALL FIELDS	JOB=MASS N= 4590
11 14 34 27 11 3	14 12 20 36 11 6 1		12 13 38 25 9 2	12 11 34 28 10 4		15 8 39 20 15 3 1	10 11 50 19 8 2		13 10 28 27 18 3 1	13 13 21 38 11 3 1	
HS =R.I. N= 563	HS TO PHD ALL FIELDS	PHD=R.I. N= 529	BA =R.I. N= 712	BA TO PHD ALL FIELDS	PHD=R.I. N= 529	PHD=R.I. N= 431	PHD TO JOB ALL FIELDS	JOB=R.I. N= 407	HS =R.I. N= 440	HS TO JOB ALL FIELDS	JOB=R.I. N= 407
13 12 11 45 15 3	10 12 12 52 9 5		14 16 10 46 12 3	9 14 14 50 9 5		14 12 16 36 17 3 1	7 15 17 46 11 3		14 10 15 36 20 3 1	12 12 17 46 10 3	
HS =CONN N= 1886	HS TO PHD ALL FIELDS	PHD=CONN N= 2661	BA =CONN N= 1962	BA TO PHD ALL FIELDS	PHD=CONN N= 2661	PHD=CONN N= 2133	PHD TO JOB ALL FIELDS	JOB=CONN N= 1739	HS =CONN N= 1490	HS TO JOB ALL FIELDS	JOB=CONN N= 1739
11 16 20 44 6 2	11 13 14 51 6 4 1		12 15 25 36 7 2	10 13 19 48 6 3		14 11 24 41 6 3 1	10 16 30 37 4 1		14 10 17 47 8 2 1	12 15 15 49 6 3 1	
HS =N.Y. N= 16921	HS TO PHD ALL FIELDS	PHD=N.Y. N= 13690	BA =N.Y. N= 14577	BA TO PHD ALL FIELDS	PHD=N.Y. N= 13680	PHD=N.Y. N= 11364	PHD TO JOB ALL FIELDS	JOB=N.Y. N= 9512	HS =N.Y. N= 13834	HS TO JOB ALL FIELDS	JOB=N.Y. N= 9512
9 15 42 26 4 1 1	8 9 52 22 5 1 2		8 14 47 23 5 1 1	8 10 50 22 6 1 2		9 7 48 25 6 2 2	6 14 57 17 3 1 1		13 11 35 32 4 2 2	9 12 51 21 4 1 2	

FIGURE 16—Continued

Move from High School to PhD with Reference State as Origin / Destination	Move from Baccalaureate to PhD with Reference State as Origin / Destination	Move from PhD to Employment with Reference State as Origin / Destination	Move from High School to Employment with Reference State as Origin / Destination
HS =N.J. N= 3976 — HS TO PHD ALL FIELDS — PHD=N.J. N= 2526	BA =N.J. N= 2305 — BA TO PHD ALL FIELDS — PHD=N.J. N= 2525	PHD=N.J. N= 2049 — PHD TO JOB ALL FIELDS — JOB=N.J. N= 3519	HS =N.J. N= 3172 — HS TO JOB ALL FIELDS — JOB=N.J. N= 3519
HS =PA. N= 7497 — HS TO PHD ALL FIELDS — PHD=PA. N= 6054	BA =PA. N= 7266 — BA TO PHD ALL FIELDS — PHD=PA. N= 6053	PHD=PA. N= 4917 — PHD TO JOB ALL FIELDS — JOB=PA. N= 4877	HS =PA. N= 6081 — HS TO JOB ALL FIELDS — JOB=PA. N= 4877
HS =OHIO N= 5391 — HS TO PHD ALL FIELDS — PHD=OHIO N= 4367	BA =OHIO N= 5779 — BA TO PHD ALL FIELDS — PHD=OHIO N= 4361	PHD=OHIO N= 3442 — PHD TO JOB ALL FIELDS — JOB=OHIO N= 3858	HS =OHIO N= 4278 — HS TO JOB ALL FIELDS — JOB=OHIO N= 3858
HS =IND. N= 2687 — HS TO PHD ALL FIELDS — PHD=IND. N= 5100	BA =IND. N= 3532 — BA TO PHD ALL FIELDS — PHD=IND. N= 5094	PHD=IND. N= 4243 — PHD TO JOB ALL FIELDS — JOB=IND. N= 2317	HS =IND. N= 2225 — HS TO JOB ALL FIELDS — JOB=IND. N= 2317
HS =ILL. N= 7306 — HS TO PHD ALL FIELDS — PHD=ILL. N= 7825	BA =ILL. N= 6634 — BA TO PHD ALL FIELDS — PHD=ILL. N= 7815	PHD=ILL. N= 6322 — PHD TO JOB ALL FIELDS — JOB=ILL. N= 4541	HS =ILL. N= 5930 — HS TO JOB ALL FIELDS — JOB=ILL. N= 4541
HS =MICH N= 3961 — HS TO PHD ALL FIELDS — PHD=MICH N= 5875	BA =MICH N= 4432 — BA TO PHD ALL FIELDS — PHD=MICH N= 5874	PHD=MICH N= 4570 — PHD TO JOB ALL FIELDS — JOB=MICH N= 3421	HS =MICH N= 3148 — HS TO JOB ALL FIELDS — JOB=MICH N= 3421
HS =WIS. N= 2951 — HS TO PHD ALL FIELDS — PHD=WIS. N= 3799	BA =WIS. N= 2723 — BA TO PHD ALL FIELDS — PHD=WIS. N= 3797	PHD=WIS. N= 2887 — PHD TO JOB ALL FIELDS — JOB=WIS. N= 2077	HS =WIS. N= 2305 — HS TO JOB ALL FIELDS — JOB=WIS. N= 2077

FIGURE 16—Continued

Move from High School to PhD with Reference State as Origin / Destination	Move from Baccalaureate to PhD with Reference State as Origin / Destination	Move from PhD to Employment with Reference State as Origin / Destination	Move from High School to Employment with Reference State as Origin / Destination
HS =MINN N= 2648	BA =MINN N= 2812	PHD=MINN N= 1809	HS =MINN N= 2115
HS TO PHD ALL FIELDS	BA TO PHD ALL FIELDS	PHD TO JOB ALL FIELDS	HS TO JOB ALL FIELDS
PHD=MINN N= 2370	PHD=MINN N= 2369	JOB=MINN N= 1583	JOB=MINN N= 1583
1 34 7 1 11 11 7 4 4 14 4 1 2	35 7 1 12 12 7 4 3 14 3 1 1	1 32 11 1 7 17 4 3 8 14 1 1	1 23 11 2 8 15 7 4 6 16 4 1 2
38 5 4 14 10 9 2 4 10 2 1	42 5 3 11 10 9 2 4 11 2 1	36 5 1 14 10 10 4 2 13 2 1 1	31 4 3 14 9 12 2 3 16 2 1 1
HS =IOWA N= 2389	BA =IOWA N= 2550	PHD=IOWA N= 2580	HS =IOWA N= 1907
HS TO PHD ALL FIELDS	BA TO PHD ALL FIELDS	PHD TO JOB ALL FIELDS	HS TO JOB ALL FIELDS
PHD=IOWA N= 3205	PHD=IOWA N= 3203	JOB=IOWA N= 1291	JOB=IOWA N= 1291
2 1 1 35 26 8 5 18 18 5 1 2 5 1	2 37 29 7 5 19 20 5 1 1 4 1	1 21 43 10 4 22 20 3 5 5 5 1 2	1 17 1 1 1 26 13 4 18 26 5 4 4 5 1 1
26 5 4 26 17 4 4 4 5	29 6 4 24 18 4 4 3 5	43 4 4 19 16 4 1 2 5	25 5 4 25 21 3 4 4 4
HS =MO. N= 2863	BA =MO. N= 2648	PHD=MD. N= 1673	HS =MO. N= 2307
HS TO PHD ALL FIELDS	BA TO PHD ALL FIELDS	PHD TO JOB ALL FIELDS	HS TO JOB ALL FIELDS
PHD=MO. N= 2102	PHD=MD. N= 2101	JOB=MD. N= 1745	JOB=MO. N= 1745
1 2 1 1 3 11 28 8 4 19 13 4 3 2 2	1 2 1 2 9 33 7 4 19 13 2 2 2 2	2 3 2 7 34 8 3 15 15 1 5 2 3	1 2 2 2 10 24 11 4 13 17 4 4 3 3 1
1 3 7 38 4 3 17 12 1 4 3 2	2 3 6 42 4 2 18 10 1 4 2 2	1 5 3 5 11 33 5 3 18 10 1 6 1 3	1 1 2 3 4 10 31 4 3 18 13 1 4 3 2
HS =N.D. N= 538	BA =N.D. N= 372	PHD=N.D. N= 147	HS =N.D. N= 429
HS TO PHD ALL FIELDS	BA TO PHD ALL FIELDS	PHD TO JOB ALL FIELDS	HS TO JOB ALL FIELDS
PHD=N.D. N= 179	PHD=N.D. N= 178	JOB=N.D. N= 217	JOB=N.D. N= 217
12 7 6 5 4 11 6 5 31 4 1 6	19 7 5 8 2 8 6 6 31 3 1 5	23 3 2 23 1 6 4 5 20 7 3 3	16 1 1 1 5 6 10 9 41 1 3 5
37 3 2 32 1 3 2 4 12 2 2	39 2 3 29 1 2 1 3 16 2 2	3 2 23 1 6 4 5 20 7 3 3	24 3 5 10 5 14 3 3 22 12 2 8
HS =S.D. N= 637	BA =S.D. N= 515	PHD=S.D. N= 80	HS =S.D. N= 508
HS TO PHD ALL FIELDS	BA TO PHD ALL FIELDS	PHD TO JOB ALL FIELDS	HS TO JOB ALL FIELDS
PHD=S.D. N= 86	PHD=S.D. N= 86	JOB=S.D. N= 278	JOB=S.D. N= 278
5 9 4 19 22 11 7 5 14 2 1	6 5 4 17 23 11 6 7 17 2 3	1 21 6 1 14 11 5 6 28 1 4	2 14 11 2 10 20 13 4 5 10 4 4 1
35 2 2 23 9 2 1 5	38 2 1 34 13 1 6 2 1 1	6 4 4 13 16 11 16 6 20 3 2	25 4 3 21 18 9 3 6 10 1
HS =NEB. N= 1460	BA =NEB. N= 1299	PHD=NEB. N= 696	HS =NEB. N= 1183
HS TO PHD ALL FIELDS	BA TO PHD ALL FIELDS	PHD TO JOB ALL FIELDS	HS TO JOB ALL FIELDS
PHD=NEB. N= 835	PHD=NEB. N= 833	JOB=NEB. N= 657	JOB=NEB. N= 657
1 2 3 29 8 7 12 20 11 1 3 3	1 5 34 7 7 12 18 8 1 3 2	2 1 5 37 5 4 13 13 10 3 3 3	2 1 3 20 11 5 13 17 15 3 5 4 1
2 2 3 50 3 3 17 10 5 1 2 1	1 3 54 2 4 15 10 4 1 2 2	1 2 39 5 7 6 20 9 1 4 5	1 4 36 3 5 14 16 9 2 3 5
HS =KAN. N= 1958	BA =KAN. N= 1929	PHD=KAN. N= 930	HS =KAN. N= 1591
HS TO PHD ALL FIELDS	BA TO PHD ALL FIELDS	PHD TO JOB ALL FIELDS	HS TO JOB ALL FIELDS
PHD=KAN. N= 1216	PHD=KAN. N= 1216	JOB=KAN. N= 1120	JOB=KAN. N= 1120
1 4 1 14 21 7 3 14 15 11 1 3 2	1 3 2 13 24 5 4 15 16 9 1 3 2	1 2 2 2 8 24 5 4 14 16 9 1 8 3 1	2 4 2 15 20 4 4 17 17 9 1 3 1
2 3 9 34 3 2 19 7 12 2 3 3	1 3 6 38 2 3 18 10 9 2 3 3	2 2 11 21 4 3 12 13 12 1 6 3 1	2 1 3 13 30 4 3 17 12 9 1 3 3

FIGURE 16—Continued

Move from High School to PhD, with Reference State as Origin	Destination	Move from Baccalaureate to PhD with Reference State as Origin	Destination	Move from PhD to Employment with Reference State as Origin	Destination	Move from High School to Employment with Reference State as Origin	Destination
HS =DEL. N= 242	HS TO PHD ALL FIELDS	PHD=DEL. N= 250	BA =DEL. N= 157	BA TO PHD ALL FIELDS	PHD=DEL. N= 250	PHD=DEL. N= 208	PHD TO JOB ALL FIELDS	JOB=DEL. N= 770	HS =DEL. N= 191	HS TO JOB ALL FIELDS	JOB=DEL. N= 770
HS =MD. N= 1312	HS TO PHD ALL FIELDS	PHD=MD. N= 2006	BA =MD. N= 1477	BA TO PHD ALL FIELDS	PHD=MD. N= 2002	PHD=MD. N= 1644	PHD TO JOB ALL FIELDS	JOB=MD. N= 2246	HS =MD. N= 1093	HS TO JOB ALL FIELDS	JOB=MD. N= 2246
HS =D.C. N= 738	HS TO PHD ALL FIELDS	PHD=D.C. N= 1896	BA =D.C. N= 821	BA TO PHD ALL FIELDS	PHD=D.C. N= 1893	PHD=D.C. N= 1528	PHD TO JOB ALL FIELDS	JOB=D.C. N= 2171	HS =D.C. N= 597	HS TO JOB ALL FIELDS	JOB=D.C. N= 2171
HS =VA. N= 1541	HS TO PHD ALL FIELDS	PHD=VA. N= 912	BA =VA. N= 1388	BA TO PHD ALL FIELDS	PHD=VA. N= 911	PHD=VA. N= 752	PHD TO JOB ALL FIELDS	JOB=VA. N= 1355	HS =VA. N= 1260	HS TO JOB ALL FIELDS	JOB=VA. N= 1355
HS =W.VA N= 853	HS TO PHD ALL FIELDS	PHD=W.VA N= 172	BA =W.VA N= 708	BA TO PHD ALL FIELDS	PHD=W.VA N= 172	PHD=W.VA N= 137	PHD TO JOB ALL FIELDS	JOB=W.VA N= 392	HS =W.VA N= 667	HS TO JOB ALL FIELDS	JOB=W.VA N= 392
HS =N.C. N= 1470	HS TO PHD ALL FIELDS	PHD=N.C. N= 2520	BA =N.C. N= 1846	BA TO PHD ALL FIELDS	PHD=N.C. N= 2518	PHD=N.C. N= 1980	PHD TO JOB ALL FIELDS	JOB=N.C. N= 1703	HS =N.C. N= 1205	HS TO JOB ALL FIELDS	JOB=N.C. N= 1703
HS =S.C. N= 679	HS TO PHD ALL FIELDS	PHD=S.C. N= 169	BA =S.C. N= 690	BA TO PHD ALL FIELDS	PHD=S.C. N= 169	PHD=S.C. N= 147	PHD TO JOB ALL FIELDS	JOB=S.C. N= 540	HS =S.C. N= 528	HS TO JOB ALL FIELDS	JOB=S.C. N= 540

FIGURE 16—Continued

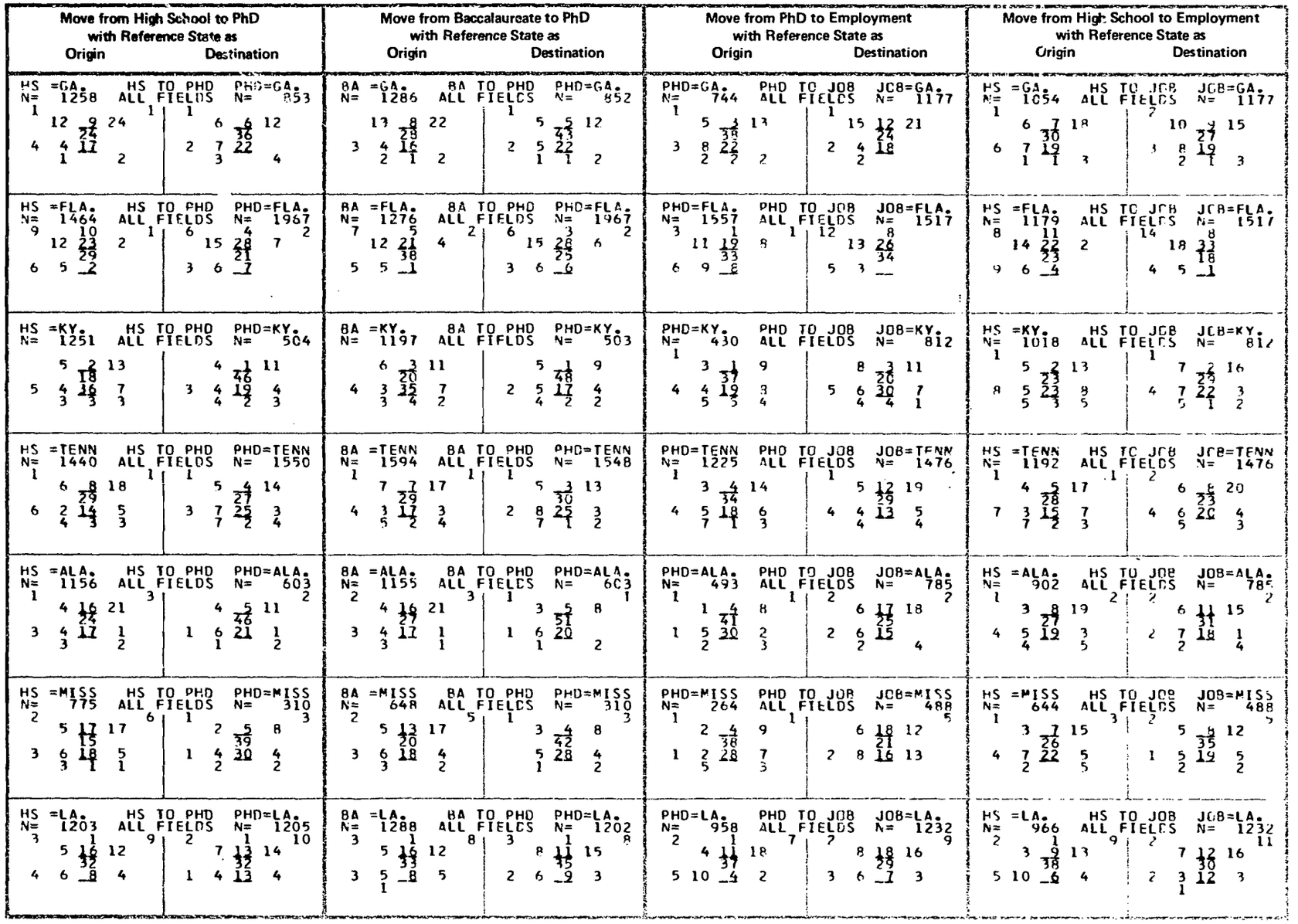


FIGURE 16—Continued

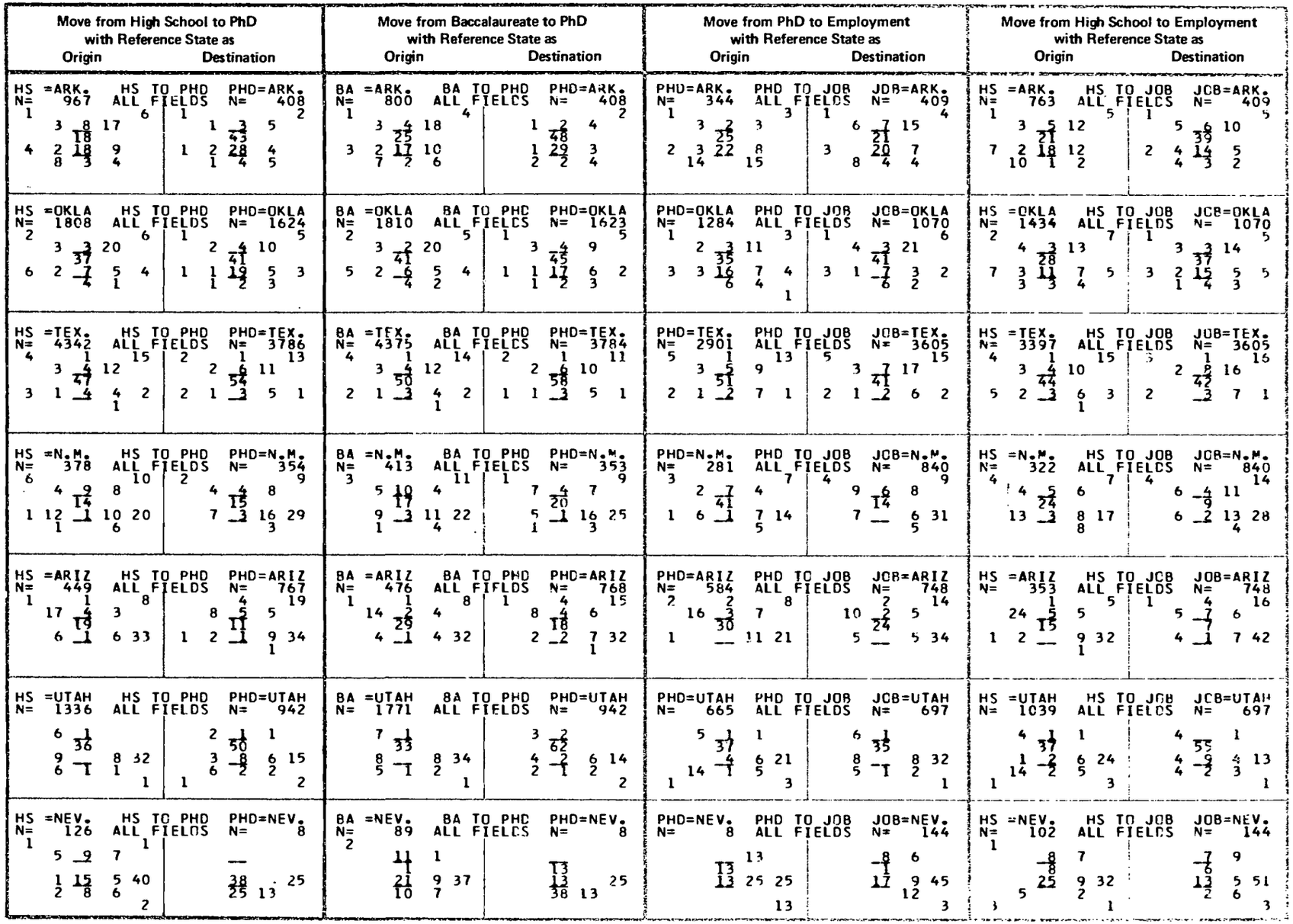
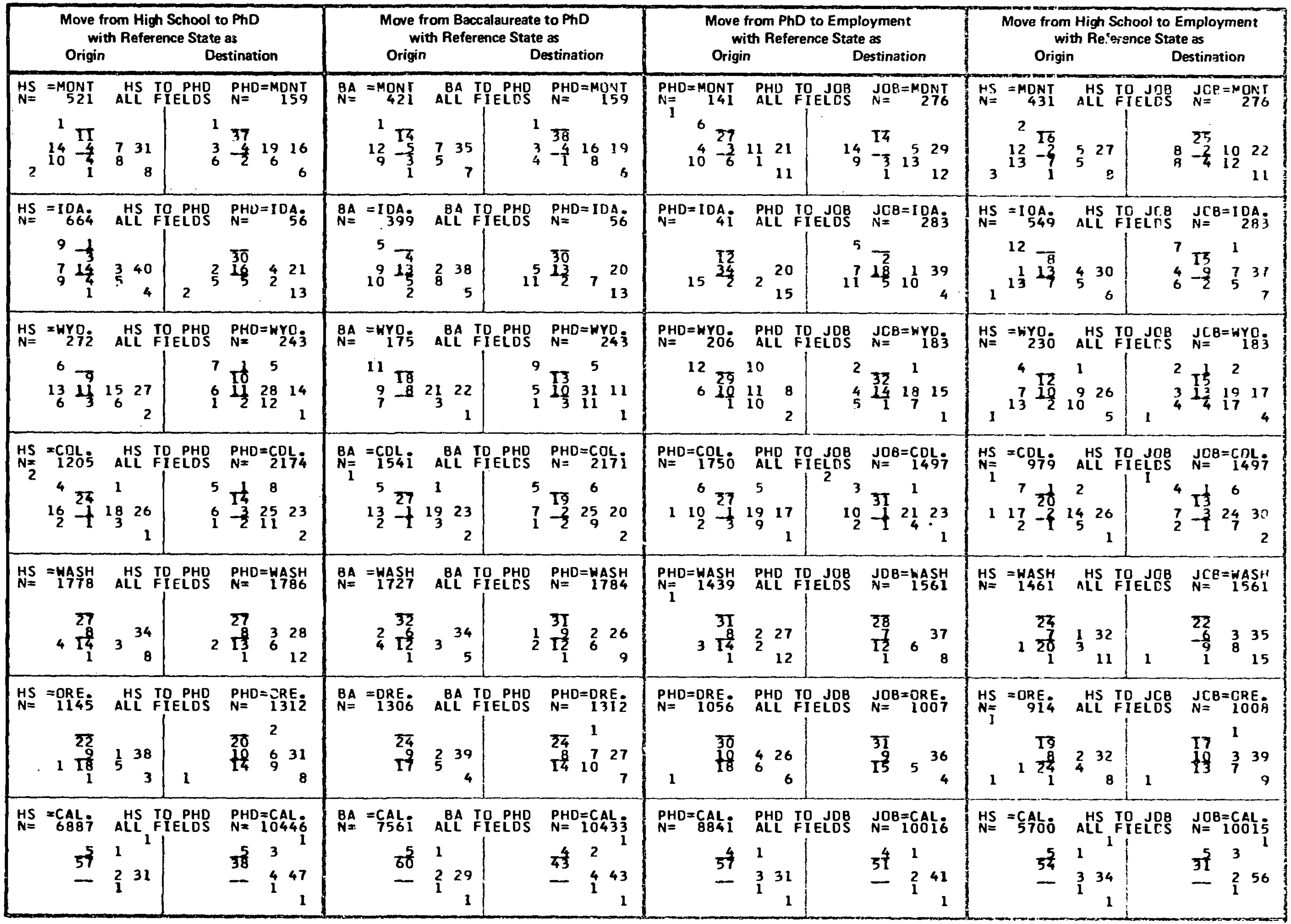


FIGURE 16—Continued



CHAPTER IV CORRELATES OF MIGRATION: STATE INDICES OF PROSPERITY AND EDUCATION

Up to this point we have been concerned with the statistical facts of the migration of PhD's, or those who eventually attain PhD's. We have looked at their movements out of the states of their origin and into the states of their postdoctoral destination. The question inevitably arises: What are the forces that move them in these directions and over these distances? To attempt an answer to this question, it was necessary to consider the environing conditions in the several states and to develop quantitative measures that might help to provide some answers to the questions of "pushes" and "pulls" on this group of people. Hopefully, too, such analysis of state data might cast some glimmerings of light on the question of the *effects* of migrations, as well as the causes. To this end, an extensive file of state data was built up, and subjected to analyses that led eventually to the development of three indices that are useful as frames of reference to interpret the movements of the PhD's.

155 VARIABLES AND 5 FACTOR ANALYSES

The data considered to be relevant to this question were those tables that depict economic factors, educational factors, and migration factors for the various states. Altogether, 155 basic variables were assembled for each state. They and their sources are listed in Appendix E. Some of these variables were then combined in various ways, such as ratios, and a selected set subjected to several factor analysis runs (for details see Appendix F). These analyses helped in the selection and combination of three indices, relating, respectively, to (1) elementary and secondary education, (2) higher education, and (3) economic prosperity, for each state. These three indices were chosen because it seemed most important to be able to interpret the high school origins, and movement from state of high school to state of higher education, and later from state of university training to state of employment. Several hypotheses might be developed and tested by using such indices and the migration data jointly. For example, it would seem reasonable that a state that had very good elementary and secondary education, but was not so well-developed at the higher education level would tend to lose people after high

school to those states that had better-developed higher educational systems. In the present context, it would not particularly matter whether the education at either level were primarily public or private. This may matter a great deal for a number of purposes, but here the two sources of support are combined. It is migration as such that is to be interpreted. A net high school-to-college in-migration would be expected in a state with a very good higher education system, but with secondary education that was not quite so outstanding. The comparison of the out-going and in-coming migration diagrams would be expected to show a flow differential, perhaps in distance moved as well as numbers, if the higher education institutions were of national renown.

At the stage of movement from PhD to job, two kinds of considerations apply. Most PhD's enter academic employment (about 60 percent of the total, less for the physical sciences and more for the humanities). The relative strength of the higher education systems would therefore be expected to create a flow to those states with excellent higher education, except that these same states would tend to have an excess "for export." The strength of the economy would be expected to provide a magnet for those whose destination was nonacademic employment. Taking these two factors together, one would then expect flow from PhD to job to align itself with a *differential* between the strength of the higher education system and the economic prosperity of the state. A further consideration for many of these people would be the educational opportunities that the state might afford for their children. A strong elementary–secondary educational system would, therefore, be expected to provide a magnet: PhD-to-job migration would be expected to flow along the lines of a differential between the higher education and elementary–secondary educational systems of the states—the opposite direction from the high school-to-college migration on the way to the PhD.

A number of such hypotheses might be constructed and tested. It is the aim of this report to provide the data that will permit an initial examination of such questions as these. The indices developed (economic prosperity and of educational development) are not considered final; they are first approximations that may afford a beginning step in the analysis of the relationships between economic and educational factors. The composition of the three indices is always subject to revision, and it is quite possible that indices differently constructed would show somewhat different results. For example, it is known that there is a negative correlation between economic status and economic growth. This is a familiar finding in social statistics; states that are at the bottom of the ladder can make relatively greater progress, on a percentage basis, than those at the top. Therefore, if an index of economic growth were to be substituted for one of economic status, quite different results would be obtained. It would no doubt be useful to employ such an index, or any of a number of others that could conceivably be developed. However, within the limits of this initial report, it was felt advisable to limit the number of relationships to be examined to three, as described earlier. For future studies, not only economic growth, but differences between undergraduate and graduate education might well be explored further, and differences between public and private educational systems. Also, time differentials, or growth indices for the educational systems, and time differentials in migration patterns, correlated with economic changes, might well yield a much more dynamic view of the relationships between and among the various fac-

tors here encountered. Limits of space, time, and resources forbid the further exploration of these interesting questions here.

THE THREE STATE INDICES

The state index of economic prosperity was built around the data on per capita personal income from a number of sample years from 1929 to the present. These several years all intercorrelate rather highly; the effect of using several years was to produce an index showing the opportunities that have existed over a long enough time to become well-known and stable. The personal income per capita variable received the greatest weight in the index chosen. "Value added in manufacture" in the state, using the Department of Commerce data for 1963 and 1964, and percentage of the population employed (1960 census) were also used. The weights given were subjective and to an extent arbitrary. They are not regression weights; if available, criterion that could produce regression weights would have been chosen. The same holds for the components of the other variables and their weights; they were selected by the author on an essentially subjective judgmental basis, and it is recognized that other weights might with equal validity be chosen instead. The three variables used in the economic prosperity index have modest intercorrelations and, together, provide a somewhat broader base for this index than would income alone. The weights given to each were as follows:

Personal income per capita	60%
Value added in manufacture, 1963 and 1964	20%
Percentage of the population employed, 1960 census	20%

The state index of elementary–secondary education emphasizes the economic support of the state's public school system: It was financial data that tended to have the greatest weight in those factors that reflected educational excellence. The composite was built up as follows:

Total dollars per capita for elementary–secondary education, 1964	40%
Teachers' salaries, 1964	30%
Percent of the population over 25 who completed high school, 1960	20%
Percent of draftees medically and mentally qualified, 1960	10%

The medically and mentally fit draftee figure was included because a very large proportion of draftees who fail do so for essentially educational disabilities. Further, this item appeared consistently, although with moderate weight, in those factors relating to strength of the state's elementary–secondary educational system. Because the states vary in the percentage of students in public vs. private education, a moderator for percent in nonpublic education was used with the first variable that originally referred to public education only. Thus, a state with 10 percent of its students in nonpublic elementary and secondary schools would have its "dollars per capita" figure multiplied by 1.10. This assumes that the per student cost of public and private education is equal. This is not exactly true, as denominational school costs might, on the average, be less and independent school costs more. However, exact figures are not available. In any case, the effect of this moderator is not very great, even for those states with the highest percentage of nonpublic schools, as was found by calculating the index both ways. The higher education index was built up as follows:

Percent of personal income devoted to higher education, 1960	40%
Total dollars per capita for public + private higher education, 1960	20%
Baccalaureate degrees per 1,000 population, 1956–1963 average	20%
PhD's per 1,000 population, 1956–1963 average	10%
Opening fall enrollments per 1,000 population, 1960–1965 average	10%

It is to be noted that all of these indices are placed on a per capita basis. If they were not, the enormous population differences among the states would dominate whatever indices were used, so that New York and California would regularly appear near one end of each axis, and Nevada and Alaska near the other. Each of the variables listed is first converted to a uniform basis by dividing it by its own standard deviation, before applying the weights shown above. This is essential, as there are several order-of-magnitude differences between the standard deviations of these variables. (For further development, see Appendix G.) As might be deduced from the nature of these indices, they came from several sources, principally the U.S. Department of Commerce and the U.S. Office of Education. Other variables, not employed in the indices finally decided upon, came from a number of other sources.

Using the formulas given above, the three indices were calculated, yielding in each case a 3-digit index for each state. Table 15 gives the indices for each state. The mean of each index is 500, and the standard deviation is 100. A description of how these indices were standardized, and the three indices for each state are given in Appendix G.

STATE-TO-STATE VARIATIONS DEPICTED

Distributions of these indices, in scaled terms, are given in Figure 17: The per capita economic prosperity index has a slight positive skew; the higher education index is highly skewed; and the elementary–secondary school index has a slight negative skew. The strong positive skew of the higher education index means that the states, rather than forming a normal distribution on this variable, spread out farther above the mean than below it. The four outstanding "states" are the District of Columbia, Utah, Vermont, and Massachusetts. The outstanding position of the New England states is perhaps no surprise, and Utah's long-standing devotion to educational excellence is also well-known. The position of Washington, D.C., in this respect, is somewhat of a surprise, however. The reason is that these are per capita figures, and the District is a wholly urban area of about 60 square miles, with a dozen or so accredited universities or colleges. The support for these institutions, both public and private, is largely national, rather than local, which puts the District of Columbia in a category by itself. (It is also true that several of the institutions that give Massachusetts, for example, its high rating also have what is in essence a national constituency.) Interestingly, none of the states is more than 1½ standard deviations below the mean, i.e., no state has a scaled score below 350. The recent rapid progress of the states lowest on this scale has minimized the very serious lags that would have been evident a generation ago.

The mild positive skew of the economic index is scarcely a surprise. Perhaps the surprise should be that it is not greater, in view of the extreme skew of individual income distributions, or other indices of individual wealth. In the present case, however, we are dealing with state-by-state aggregates of individuals, and wealthy individuals are found in even the poorest states, as well as extreme poverty in even the wealthiest states.

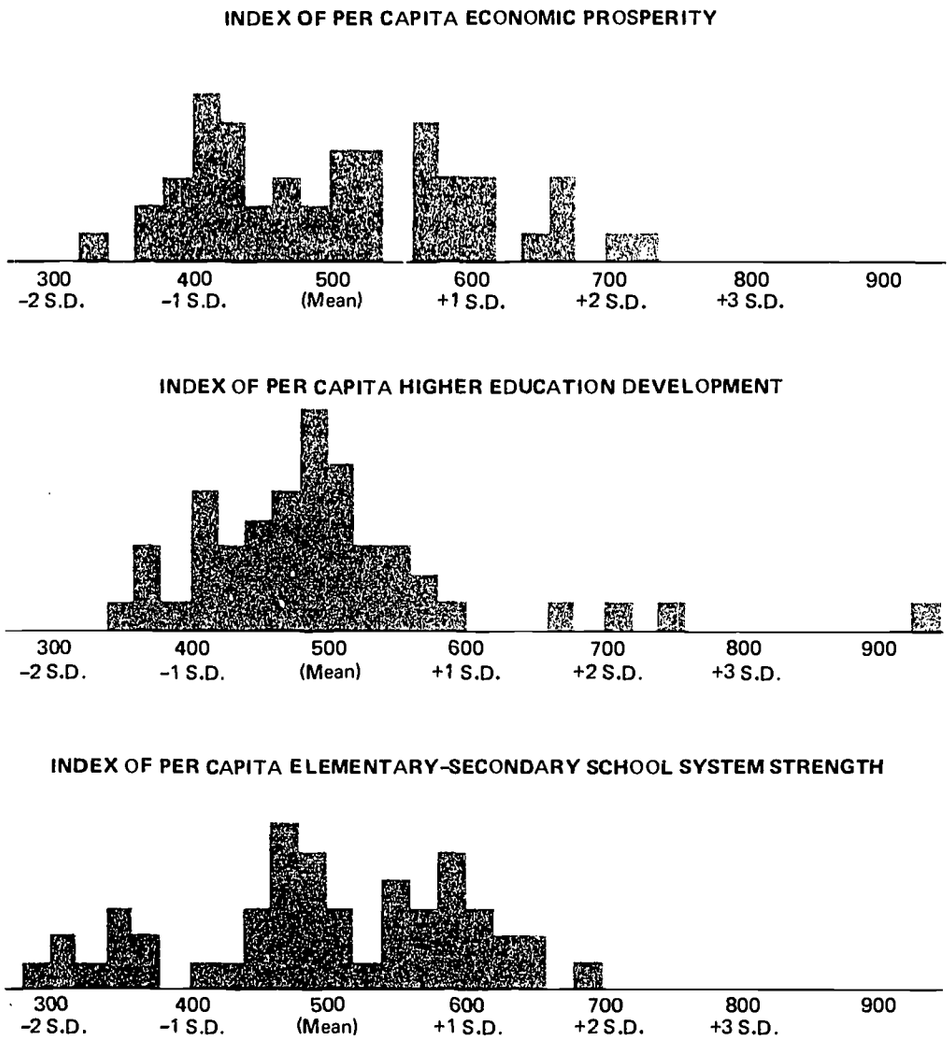
TABLE 15

Rank Orders of States on Three Indices (Data from Appendix Table G-1)

	Economic Prosperity		Higher Education		Elementary-Secondary	
Rank	State	Score	State	Score	State	Score
1	D.C.	725	D.C.	925	California	699
2	Connecticut	699	Utah	749	Utah	646
3	Delaware	662	Massachusetts	705	Oregon	640
4	New Jersey	660	Vermont	677	Colorado	633
5	Illinois	659	Colorado	596	Washington	627
6	New York	650	Iowa	569	Delaware	605
7	Massachusetts	609	New Hampshire	568	Wyoming	605
8	Michigan	598	South Dakota	557	Nevada	604
9	California	596	California	552	New Mexico	595
10	Ohio	586	Minnesota	542	Minnesota	592
11	Rhode Island	580	Indiana	528	Michigan	591
12	Nevada	579	North Dakota	528	New York	591
13	Indiana	574	Kansas	528	Arizona	586
14	Pennsylvania	565	Nebraska	515	Wisconsin	571
15	Washington	559	Oklahoma	514	Indiana	567
16	Wisconsin	557	Oregon	513	Montana	561
17	Maryland	555	Rhode Island	509	Connecticut	551
18	New Hampshire	531	North Carolina	507	Iowa	551
19	Missouri	530	Maryland	506	Kansas	548
20	Oregon	528	Michigan	498	Illinois	545
21	Iowa	519	Washington	498	Massachusetts	528
22	Minnesota	506	Illinois	495	Maryland	516
23	Nebraska	502	Louisiana	491	New Jersey	511
24	Kansas	501	New York	488	North Dakota	501
25	Wyoming	496	Montana	485	Ohio	499
26	Colorado	492	Wisconsin	485	Nebraska	499
27	Montana	475	Wyoming	483	D.C.	495
28	Vermont	474	Arizona	476	Pennsylvania	488
29	Maine	457	Connecticut	475	Vermont	482
30	Texas	455	Tennessee	470	Idaho	478
31	Virginia	450	Mississippi	468	Florida	478
32	Idaho	438	New Mexico	468	Rhode Island	474
33	Utah	431	Missouri	450	South Dakota	474
34	Oklahoma	426	Pennsylvania	449	Oklahoma	472
35	Georgia	425	Arkansas	448	New Hampshire	467
36	North Carolina	423	Idaho	445	Texas	456
37	West Virginia	417	Texas	436	Maine	448
38	South Dakota	413	Alabama	428	Missouri	447
39	Tennessee	410	Virginia	426	Virginia	430
40	Kentucky	408	Georgia	415	Louisiana	410
41	North Dakota	402	Maine	414	North Carolina	379
42	Florida	400	Ohio	414	West Virginia	362
43	Arizona	399	South Carolina	414	Georgia	356
44	South Carolina	390	Kentucky	409	Kentucky	348
45	Louisiana	386	West Virginia	389	Tennessee	342
46	Alabama	379	Florida	378	Alabama	337
47	Arkansas	366	New Jersey	364	Arkansas	316
48	New Mexico	357	Delaware	360	South Carolina	307
49	Mississippi	330	Nevada	356	Mississippi	299

FIGURE 17

Frequency distributions of three state composite indices. (Data from Table 15 and Appendix Table G–1.)



Elementary and secondary education is largely locally supported, with varying amounts of state aid and only recently any appreciable amounts of federal support. In this, it contrasts with higher education, which has had something of a national constituency for many of the colleges and universities. (The elementary–secondary index used here, it has been noted, includes an allowance for private and denominational education, but is largely public.) Accordingly, it is not unexpected that there is a mild negative skew in this variable. This is largely due to the very unfavorable position of the southern states. In per capita strength of elementary–secondary education, all nine of the states more than one standard deviation below the mean (i.e., scaled scores below 400) are in the South; none of the southern states rank above the national mean. It is well to remember that the index used for this scale emphasized financial support, to the extent of 70 percent of the weight. The remaining 30 percent was entirely nonfinancial, however. The South, on the per capita economic prosperity variable, is below average; even "wealthy

Texas" is a half a standard deviation below the U.S. mean on a per capita basis. There is thus a smaller economic base of support for education. Further, a larger proportion of the population of the South is of school age; there are fewer adults gainfully employed per 100 school children than is true of most other states.

THREE MAPS FOR THREE INDICES

To make the relationships described above more readily observed, Table 15 lists the states in rank order for each of the state composite indices; the scaled score is noted in each case. Figures 18, 19, and 20 also are helpful in this regard. They provide maps of the United States, with each state shaded to represent its relative position on one of the scales. Figure 19 shows the per capita economic prosperity picture. There are five categories, based on the scaled scores, each category covering 100 scale points. The average group includes those states from 450 to 549, i.e., one half a standard deviation on either side of the mean. There are two categories below the average: from 350 to 449, and below 350. Above the mean there are also two categories: from 550 to 649, and from 650 upward. These same scaled score ranges are used for all three of the maps. By comparing the shading for a given state or group of states on one map with that on another, the relative position on the three indices may be visualized.

FIGURE 18

Per capita economic prosperity scale.

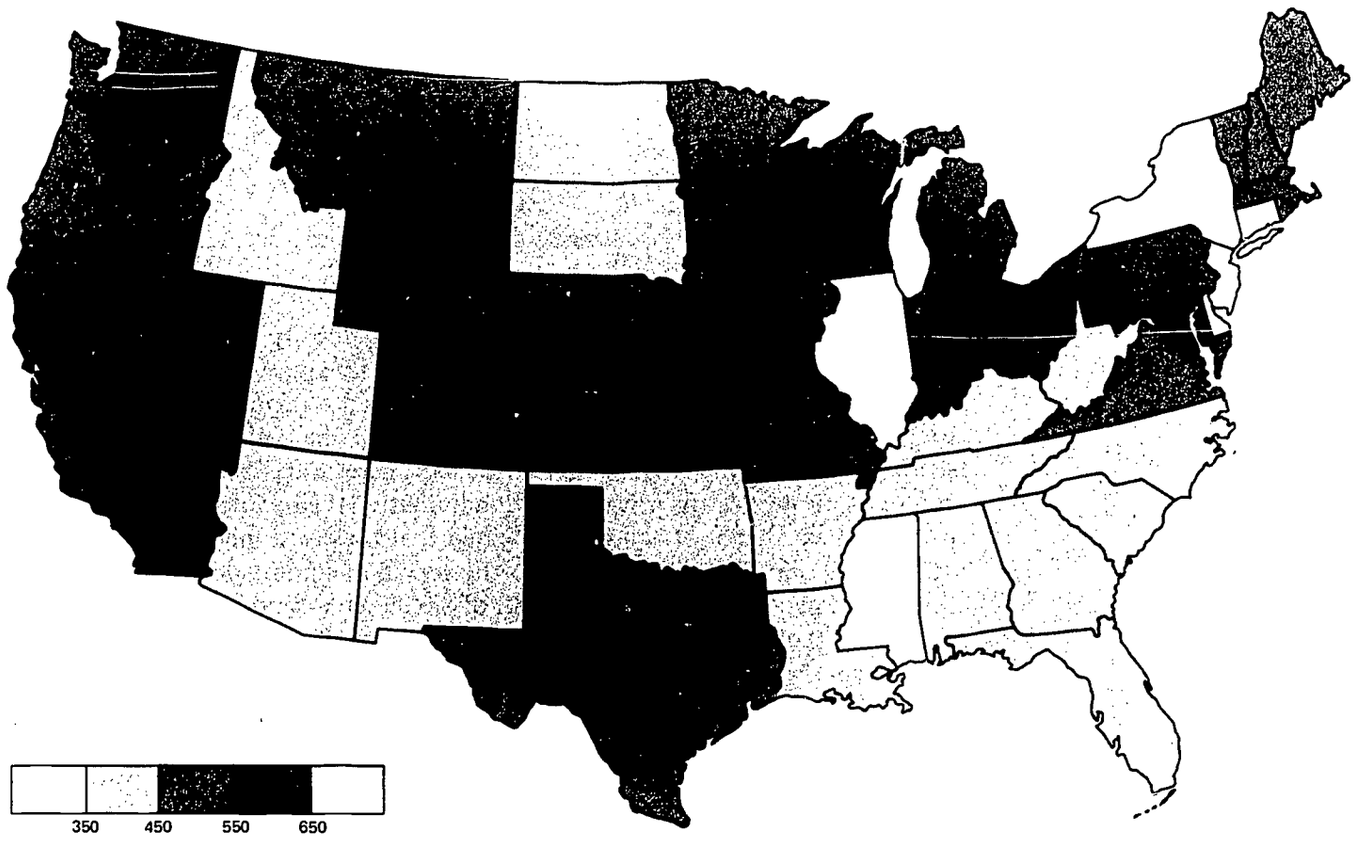
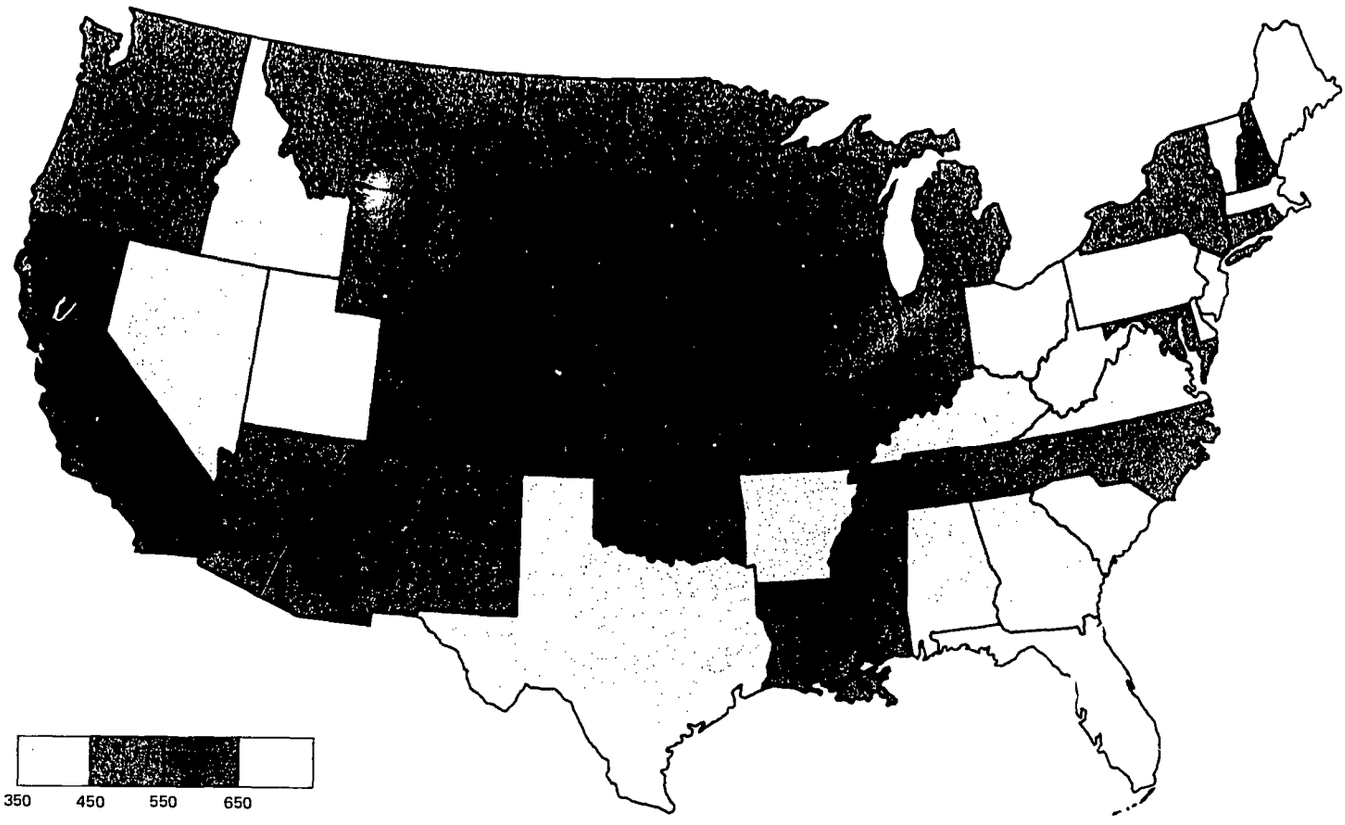


FIGURE 19

Per capita higher education scale.



Economic Prosperity Map

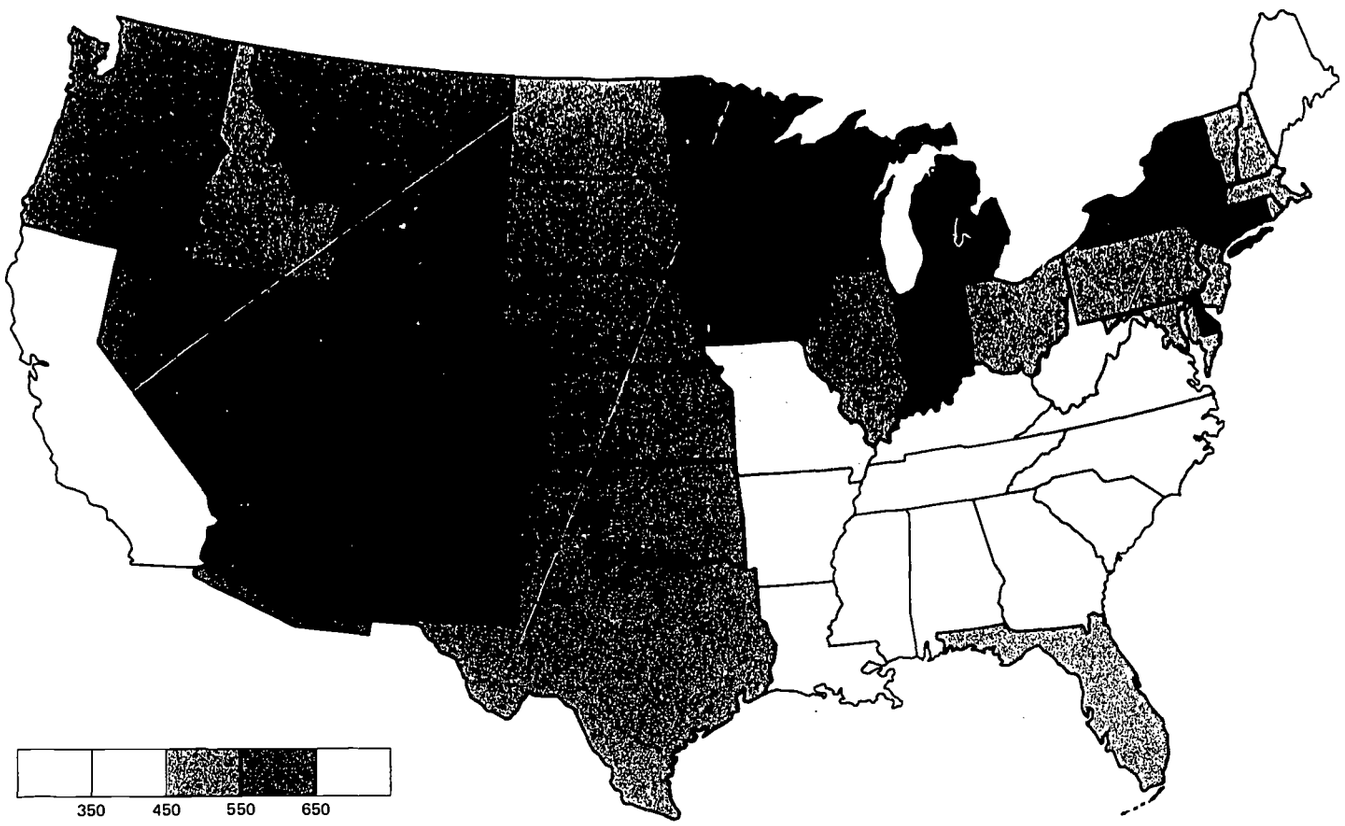
Regional groupings are quite apparent on all three maps, but they are by no means identical. On the economic prosperity map, the influence of commerce and industrial production is quite evident, although the variable "value added in manufacture" had only 20 percent of the weight. At the top of the scale are the northeastern seaboard states of New York, New Jersey, Connecticut, and Delaware. Illinois also scores above 650; the other Great Lakes states are not far behind, nor are the other northeast seaboard states of Maryland, Rhode Island, and Massachusetts. The West Coast also is well above average: California and Washington rank above 550, together with Nevada, which, although large on the map, represents few people. The rest of New England, Virginia, the Midwest (except for the Rocky Mountain states), and Oregon are all in the average range. The South generally is below average: Mississippi scores below 350; the rest above 350, with Texas scoring above 450.

Higher Education Map

On the higher education map, some of the same states rate high, but there are notable shifts. At the top are Massachusetts, Utah, and Vermont; Utah is below average on the economic map. Nevada, in the next-to-top group on the economic map, is in the lowest group with respect to higher education development as are New Jersey and Delaware—both highly prosperous states. Pennsylvania and Ohio, above average economically, are below average with respect to per capita higher educational development.

FIGURE 20

Per capita strength of elementary–secondary school scale.



Elementary–Secondary Education Map

The third map, indicating per capita strength of the elementary–secondary schools, shows a heavy shift to the west that, except for Idaho, is all above average, with California in the lead. The upper Midwest is also above average, as are New York, Connecticut, and Indiana. The average band of the spectrum is made up of Idaho; a band of plains states from the Dakotas through Texas; the highly prosperous states of Illinois and New Jersey, and the relatively prosperous Ohio, Pennsylvania, Maryland, Massachusetts, and Rhode Island; and the economically average states of Vermont and New Hampshire and the less prosperous Florida. The southern and border states, from Missouri to Virginia, are below average; the East South Central states, plus Arkansas and South Carolina, rate below 350.

PAIRS OF INDICES

Some of the intercomparisons of relative position on the three scales are indicated above, and may readily be observed by comparing the maps. However, a more exact and quantitative measure of the relatedness is possible by showing the positions of the states on a scatter-diagram, taking each pair of scales at a time, and by computing rank-order coefficients of correlation. Figure 21 compares the states on the economic vs. the higher education scale. The ρ coefficient here is 0.20. Figure 22 compares them on the economic vs. the elementary–secondary scale ($\rho = 0.54$), and Figure 23 compares the two levels of education ($\rho = 0.36$). Each of these diagrams warrants study, as it

shows better than the maps, the relative position of each state in each of the three possible comparison frames. In each case, a light diagonal line indicates the "line of equality"; states on this line are equally high or low on both of the scales compared. States to one side or the other are relatively stronger on one scale than the other in proportion to their distance from the diagonal line.

Figure 21 exhibits some of the widest contrasts; this is expected with a correlation of only 0.20. Utah sharply contrasts to New Jersey and Delaware in the lower right in representing the maximum divergence with respect to existing economic resources vs. their dedication to higher education. Vermont and Nevada are another pair with a similar contrast, but not quite so extreme. The District of Columbia is off the scale in both dimensions, for reasons that were mentioned earlier. Massachusetts is high on both scales; the South generally low on both, with the noteworthy exceptions of Oklahoma and North Carolina. Some surprising comparisons are possible: for example, the Dakotas at the left middle of the diagram, with California at the right middle, indicate that, while they differ in economic status, they are very similar in per capita

FIGURE 21

Relationship of per capita strength of higher education system to per capita economic prosperity. (Based on scaled scores from Appendix Table G-1.)

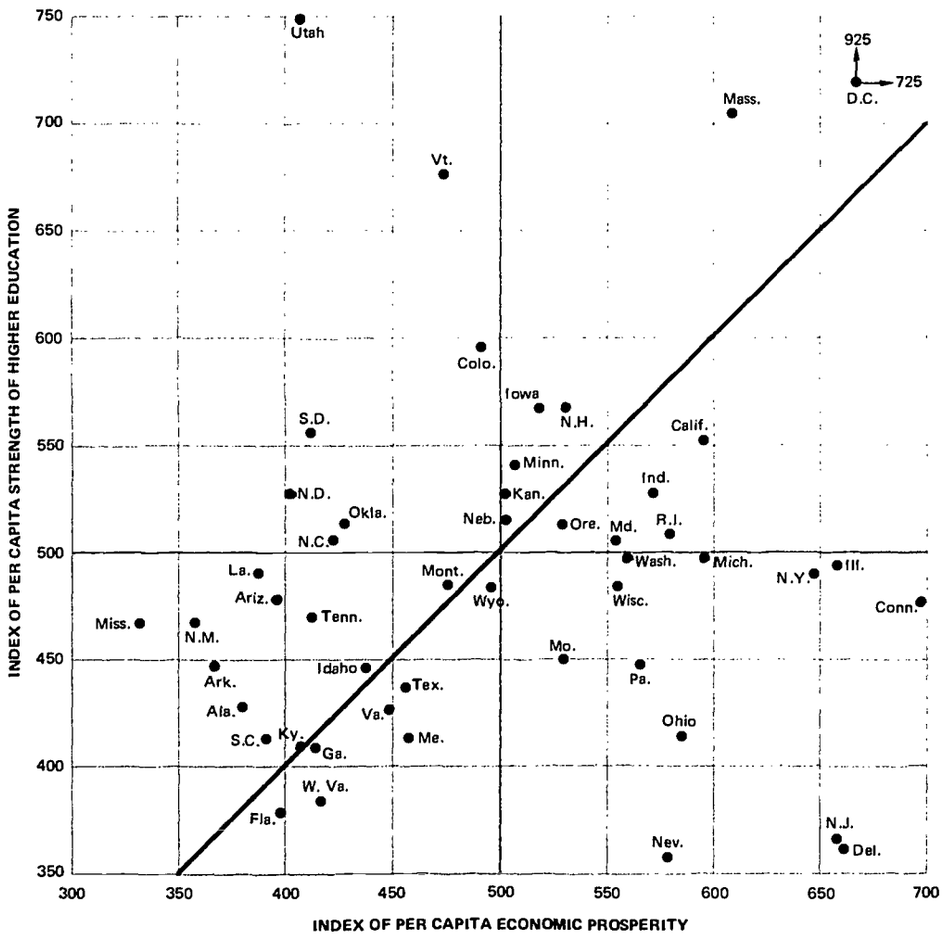
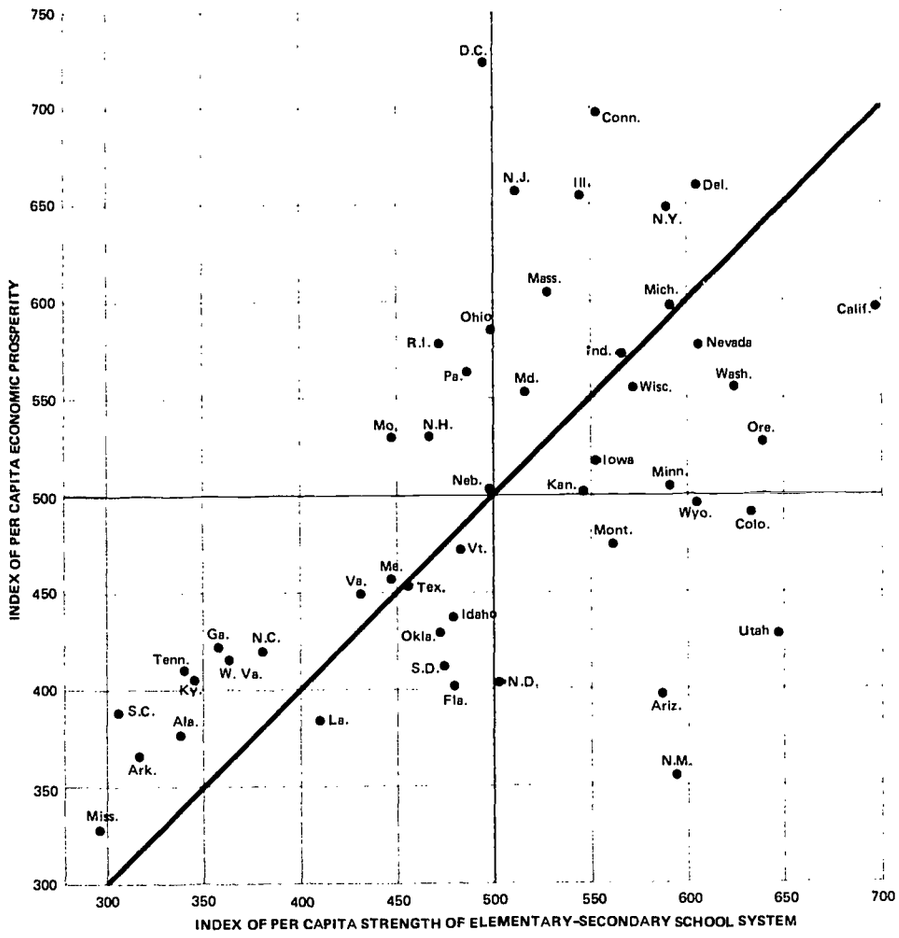


FIGURE 22

Relationship of per capita economic prosperity to per capita strength of elementary-secondary school system. (Based on scaled scores from Appendix Table G-1.)



development of higher education. The key here, of course, is per capita. The Dakotas are sparsely settled; California is the most populous state in the nation. Hence, vast differences in their higher education establishments exist but equality on a per capita basis. Another interesting comparison is that of the contiguous Midwest states of Ohio and Indiana. Similar in per capita economic status, they are widely different at the higher education level; although not generally recognized, Ohio is actually almost twice as populous.

Other groupings are noteworthy also: the West North Central states (Iowa, Minnesota, Kansas, and Nebraska) slightly above average on both axes; the West Coast about equal to them on the higher education axis but somewhat more prosperous; and the industrial states of Michigan, Illinois, New York, and Connecticut slightly below the mean on the higher education scale but averaging about 650 on the economic scale. Within the southern group, Mississippi is perhaps the most surprising in its distance from the diagonal. In proportion to available economic resources, it has attained a degree of higher education development equal to Colorado or Massachusetts. None of the

southern states is far below the "equality line"; all actually exceed such outstanding states as California and Wisconsin in this measure of relative effort.

Figure 22 shows the quantitative relationship of economic prosperity to elementary–secondary school strength. In contrast to Figure 21, there is a much closer relationship ($\rho = 0.54$) as expected because of the dependence of precollege education on local resources. The District of Columbia, at the top of the economic scale, is only average in its elementary–secondary school strength. Just below Washington, D.C. on the economic scale are the northeastern industrial states; they are above average on both scales but relatively lower on the education scale. In strong contrast are the western states, both the coastal and mountain regions. The upper Midwest, as before, tends to a substantial but unspectacular high-average position on both scales. Exceptions to both of these generalizations are to be found, of course. Rhode Island, Pennsylvania, and Ohio are slightly below average on the education scale. The same is true of the Dakotas, which, however, in relation to their per capita economic resources, are doing quite well in precollege education. Most outstanding in respect to "relative effort," however, are the Rocky Mountain states, led by New Mexico, Arizona, and Utah. The South, with the exception of Florida, lags despite their relative effort in the direction of higher education.

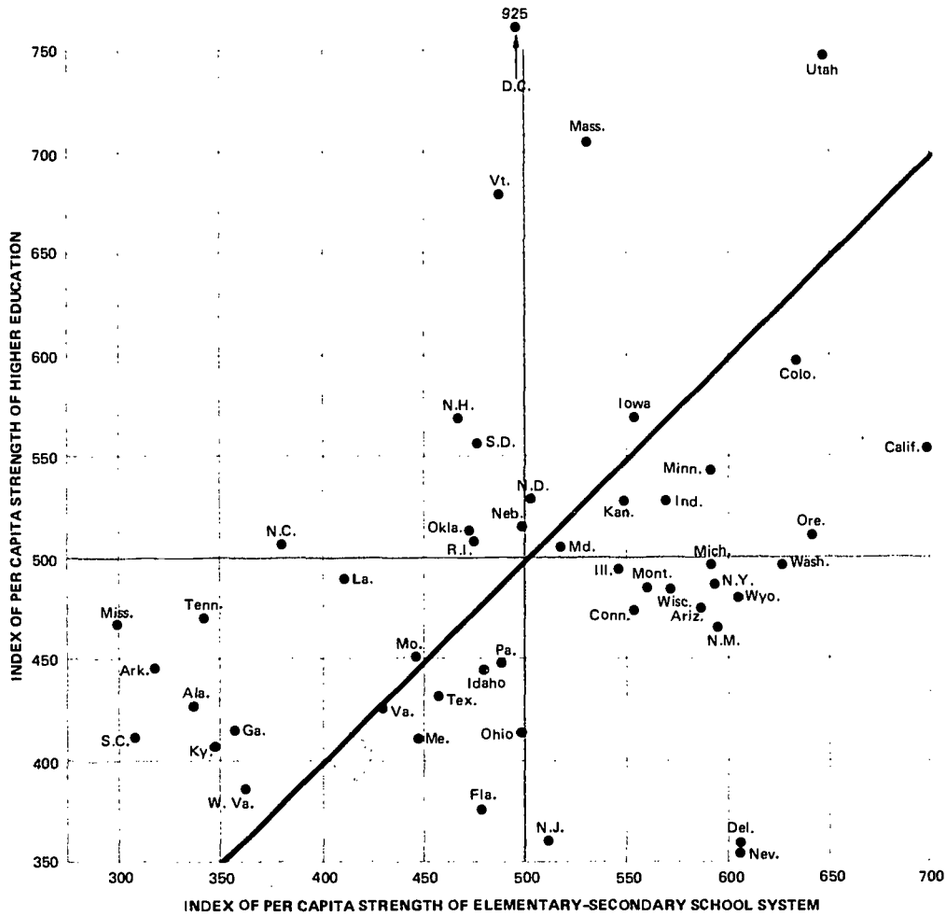
A caveat is in order in making any such specific comparisons, of course. The exact position of a state on any such diagram is dependent on the statistical definition of the variables that make up each composite. Change the definition (the variables included, their weights, or the years sampled), and the relative positions of the states will shift. However, such shifts are likely to be minor, and the general location of a state is unlikely to shift very far unless the definitions are changed radically, such as substituting economic growth rates for economic status. The approximations presented by these charts, while not exact, are nevertheless "in the right ball park" and represent realities of serious importance to the states involved.

TWO LEVELS OF EDUCATION

The intercomparison of the two educational levels is shown in Figure 23. The rank-difference correlation here is 0.36, intermediate between the other two pairs. Again, it may be most informative to first note the outstanding exceptions to the loose general rule that the two levels are correlated. Washington, D.C., Massachusetts, and Vermont are average on the precollege scale but very high on higher education. Delaware and Nevada (and to a lesser extent New Jersey) are in sharp contrast, being high on the precollege scale but very low on the higher education axis. Utah is outstandingly high on both scales; Colorado and California are well out in the same quadrant. The Midwest, in general, occupies the same ground as on the other scales–slightly to substantially above average on both. (Nebraska typifies this group; it is very near the center of all three diagrams.) Two groups of southern states appear here. They may be considered in terms of their position along the diagonal, which marks off equality of effort directed to the two levels. The group nearest the national norm on both scales includes, at one extreme, North Carolina and Louisiana with relatively more development of higher education, Virginia and Texas near the balance point, and Florida at the opposite extreme of greater effort on the elementary–secondary level; Missouri, a border state, and Maine, from New England, are mixed in with this group, close to Texas and

FIGURE 23

Relationship of per capita strength of higher education system to per capita strength of elementary-secondary school system. (Based on scaled scores from Appendix Table G-1.)



Virginia. The second group, farther from the mean on the elementary–secondary level, is putting relatively much more of its resources into higher education. This group, at the lower left in the chart, contains exclusively the remaining southern states; Oklahoma, near average on both scales, may be classified here as a border state.

TRIPLET INDICES: STATE PROFILES OF E, H, AND S

The maps consider each of the composite indices one at a time; the scatter-diagrams consider the indices in pairs. For any given state it is useful also to see the pattern of all three indices. Such patterns are shown in Figure 24, which shows one bar for each variable for each state (E, the economic prosperity index; H, the higher education index; S, the elementary–secondary school index). In general, the arrangement of the states in Figure 24 follows a geographic pattern. It is interesting to compare this set of state profiles with the similar set shown in Figure 13 (p. 42–43), which portrays PhD's per million population at each of four career stages. Although derived entirely independently, and employing different indices, there are some striking similari-

ties, both in individual states with outstanding patterns, and in general regional groupings.

In both Figures 13 and 24 the District of Columbia is in a class by itself and for similar reasons in both cases, as described earlier. Among the states, Delaware is the highest in Figure 13 as a place of employment. It is also among the highest in Figure 24 in economic prosperity. As it is high also in elementary–secondary school strength, one might expect that a great many of its high school graduates, after taking degrees elsewhere, would return to the home state for employment. However, this is not the case, as fewer than 20 percent so return, while only 5 percent of those employed in Delaware graduated from high school there, as may be seen by reference to Figure 16 (p. 53–59).

North Carolina in the southeast, Utah in the southwest, Massachusetts, Vermont, and New Hampshire in the northeast have Figure 24 profiles opposite to that of Delaware. In Figure 13, Utah and Massachusetts also contrast with Delaware, but New Hampshire and Vermont are in contrast at the baccalaureate level but similar at the PhD level. Many such comparisons of the two sets of state profiles may be made; these serve to indicate the possibilities.

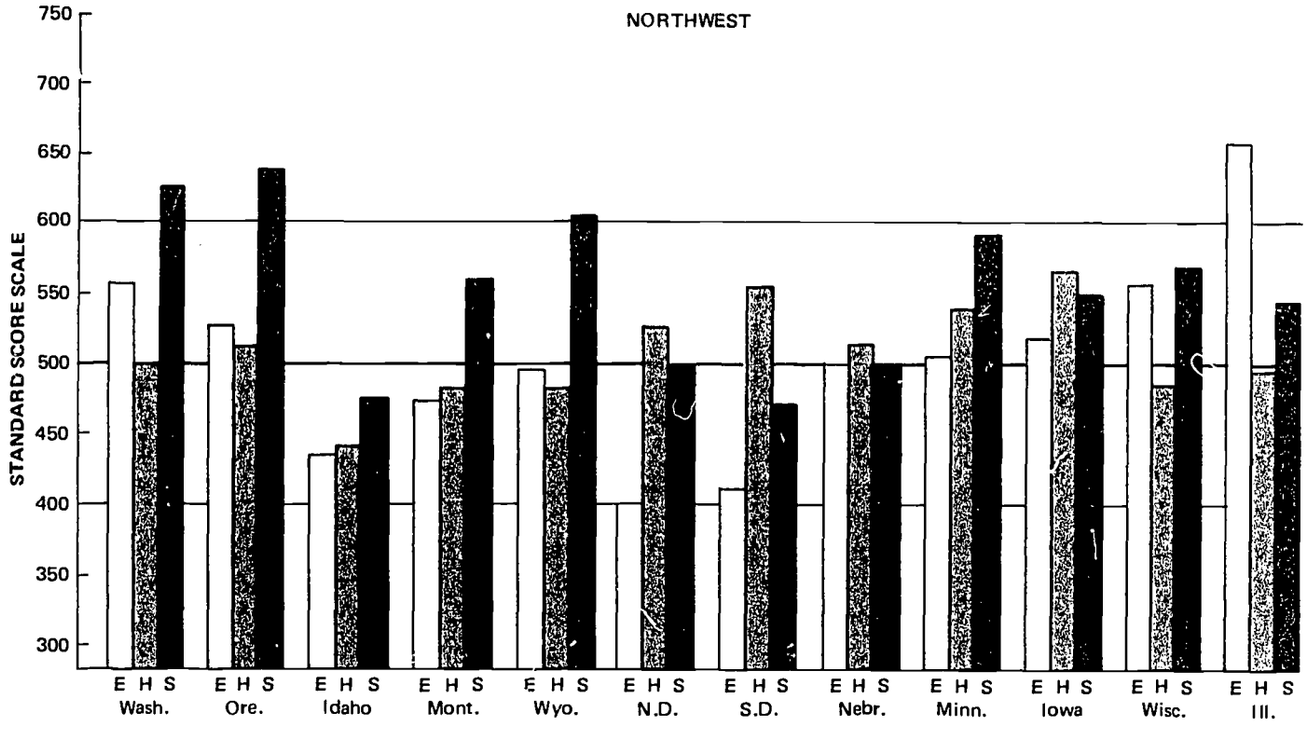
The main advantage of Figure 24 is that it presents simultaneously the states' standings on the three indices. In the western part of the country, the bars representing elementary–secondary school strength stand out; in central New England the higher education bars are dominant, while to the west and south of Massachusetts the economic index is the strongest feature. Through the Midwest all bars are rather high, and patterns are not extreme except for Illinois, Michigan, and Ohio. In the South, all of the bars are rather short, but the higher education indices are, in general, the highest, with Florida as an outstanding exception in the relative strength of its elementary–secondary school system.

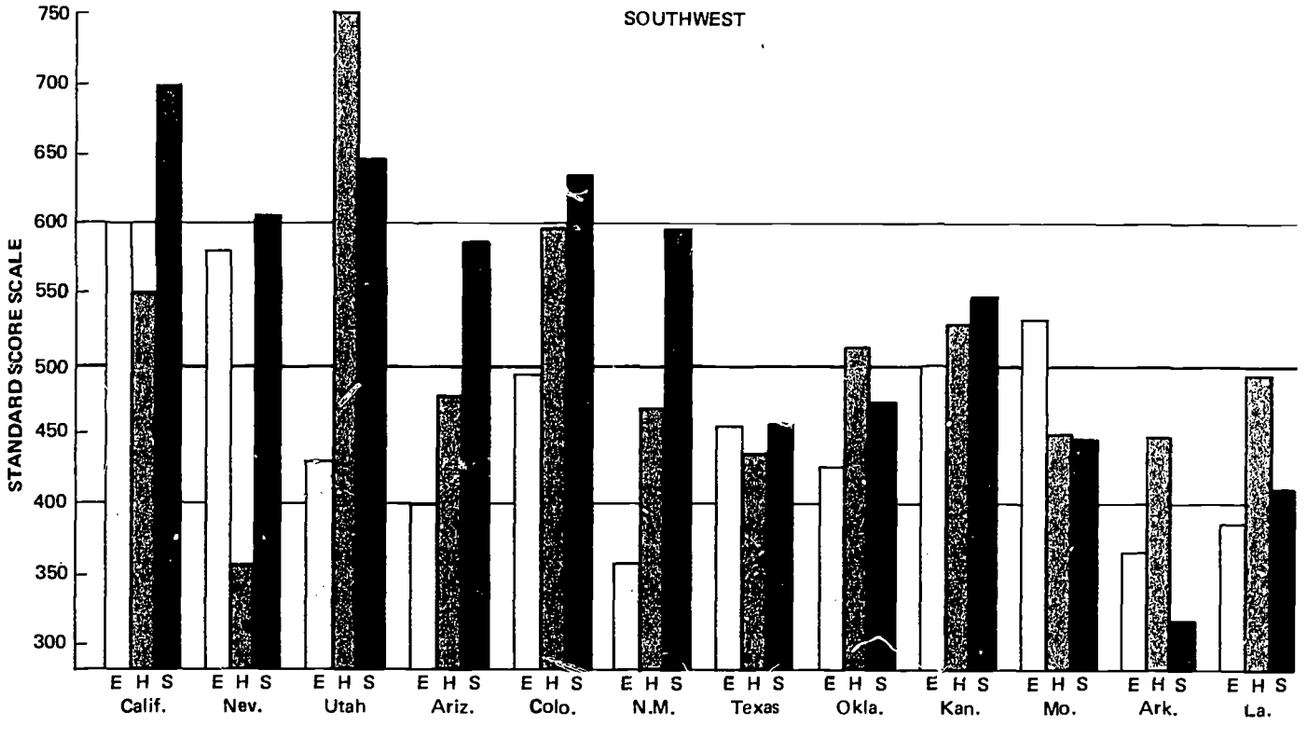
These features of the states raise questions as to what characteristics people seek in their states of employment after the PhD. If they do not stay in the state in which they graduate, what economic and educational climates do they find in the states in which they are employed? This may be formulated more precisely. Do people who leave the state in which they earn the doctorate go to states similar in higher education index, for example, or in economic prosperity? If not, do they tend to go up or down these educational and economic ladders, in terms of the relative characteristics of their states of destination? Obviously, there are many answers, as there are many patterns of movement, and it is necessary to compute statistical averages of the characteristics of the states of destination to answer these questions.

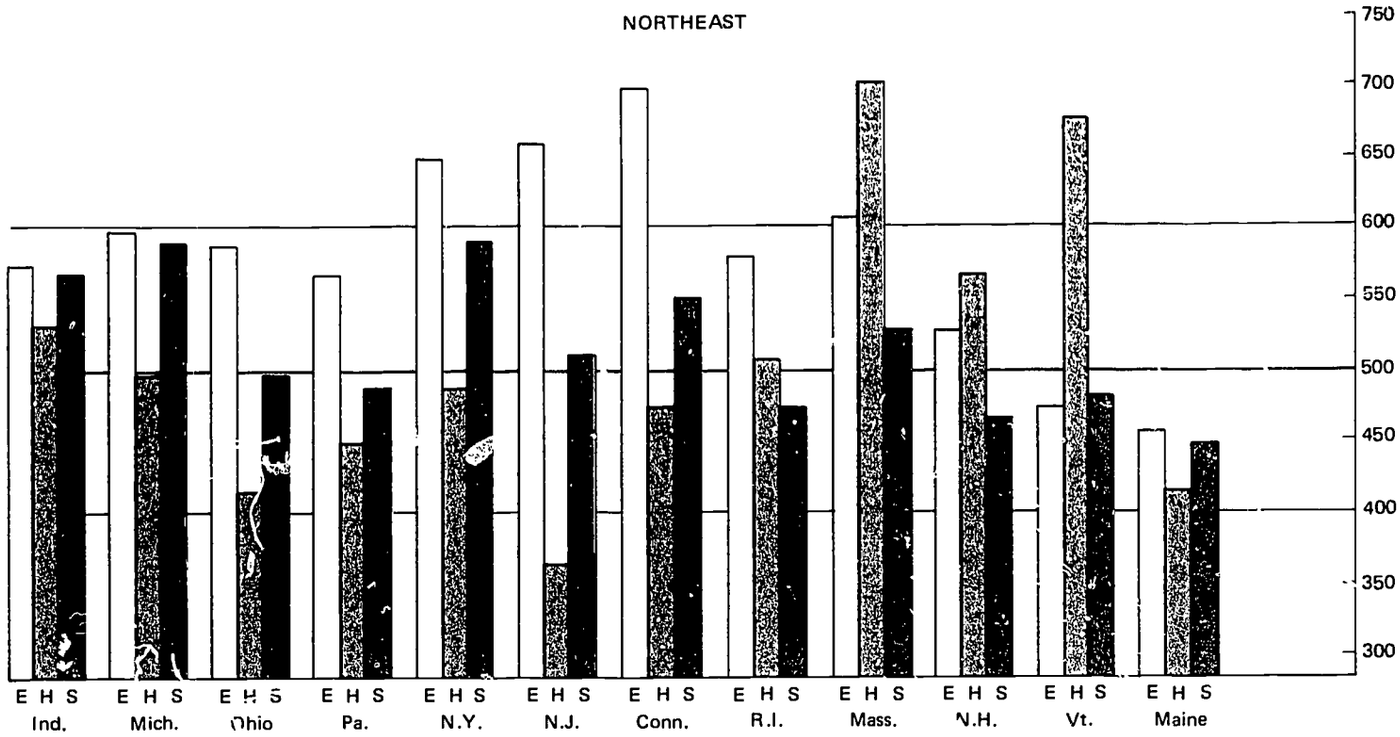
Table 16 lists the states in descending order of their higher education (H) index. It gives, for each state, the H index, and the E (economic prosperity) index. In parallel columns, it gives the mean H and E indices of the states of destination of those who move from each state of doctorate origin. These are the basic data we need to answer the questions raised above. The answers are not simple, because, in part, there are many more graduates of those states that have above-average H indices, and somewhat more states with relatively low indices. (The distributions of these indices are not quite normal, but somewhat skewed toward the upper end of the scales.) We find that graduates of all of the states tend to move, on the average, toward the mean of the United States as a whole, so that the mean "destination" values are not nearly

FIGURE 24

State profiles of economic prosperity (E), higher education development (H), and strength of elementary-secondary education (S). (Based on scaled scores from Appendix Table G-1.)






NORTHEAST
750
700
650
600
550
500
450
400
350
300
E H S
Ind.
Mich.
Ohio
Pa.
N.Y.
N.J.
Conn.
R.I.
Mass.
N.H.
Vt.
Maine

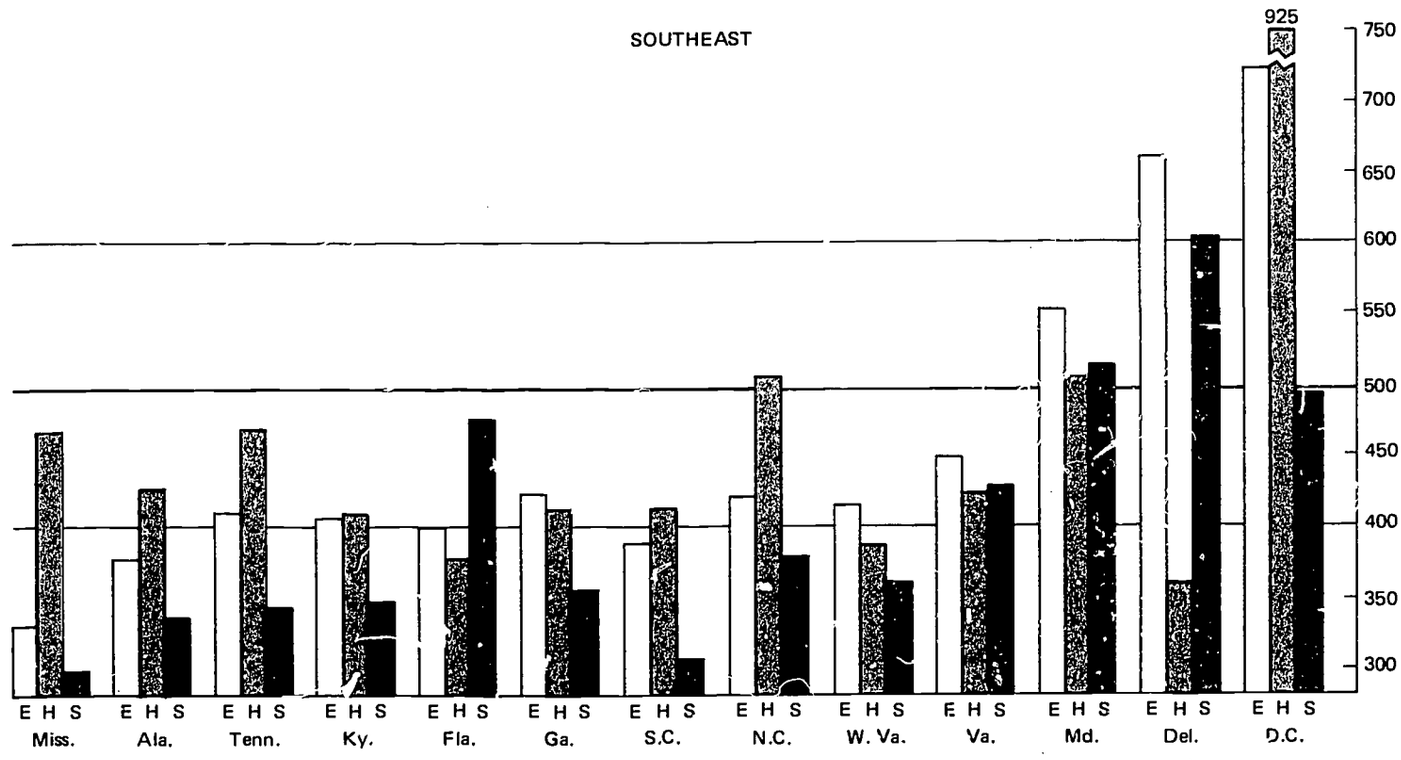

SOUTHEAST
925
750
700
650
600
550
500
450
400
350
300
E H S
Miss.
Ala.
Tenn.
Ky.
Fla.
Ga.
S.C.
N.C.
W. Va.
Va.
Md.
Del.
D.C.

TABLE 16

Characteristics of States of Destination of Those Who Leave Their State of PhD for First Postdoctoral Job

State of PhD in order of H Index	Index of PhD State		Mean Index of Destination	
	H Index	E Index	H Index	E Index
1 D.C.	925	725	493	555
2 Utah	749	431	505	539
3 Massachusetts	705	609	511	585
4 Vermont	677	474	510	598
5 Colorado	596	492	507	527
6 Iowa	569	519	498	540
7 New Hampshire	568	531	504	561
8 South Dakota	557	413	510	511
9 California	552	596	517	558
10 Minnesota	542	506	509	555
11 Indiana	528	574	494	550
12 North Dakota	528	402	511	525
13 Kansas	528	501	490	527
14 Nebraska	515	502	505	532
15 Oklahoma	514	426	484	484
16 Oregon	513	528	525	548
17 Rhode Island	509	580	527	586
18 North Carolina	507	423	479	505
19 Maryland	506	555	556	583
20 Michigan	498	598	506	557
21 Washington	498	559	517	548
22 Illinois	495	659	506	553
23 Louisiana	491	386	482	487
24 New York	488	650	497	577
25 Montana	485	475	516	525
26 Wisconsin	485	557	506	554
27 Wyoming	483	496	513	504
28 Arizona	476	399	512	535
29 Connecticut	475	699	530	578
30 Tennessee	470	410	473	485
31 Mississippi	468	330	462	429
32 New Mexico	468	357	499	527
33 Missouri	450	530	500	536
34 Pennsylvania	449	565	493	580
35 Arkansas	448	366	480	464
36 Idaho	445	438	508	547
37 Texas	436	455	501	503
38 Alabama	428	379	463	432
39 Virginia	426	450	486	518
40 Georgia	415	425	472	476
41 Maine	414	457	504	558
42 Ohio	414	586	494	549
43 South Carolina	414	390	476	470
44 Kentucky	409	408	483	513
45 West Virginia	389	417	477	528

TABLE 16

Characteristics of States of Destination of Those Who Leave Their State of PhD for First Postdoctoral Job—Continued

State of PhD in order of H Index	Index of PhD State		Mean Index of Destination	
	H Index	E Index	H Index	E Index
46 Florida	378	400	480	495
47 New Jersey	364	660	520	576
48 Delaware	360	662	479	579
49 Nevada	356	579	507	517

as varied as are the values for the individual states. This is the familiar phenomenon of regression, noted in all such correlations: There are 19 states that are above the mean of 500 on the H index. (Note the positive skew of this index in Figure 17, p. 65.) These 19 have an average H index of 584. The people who earn PhD's in these states and then take jobs in other states tend to go to states with lower H indices. On the average, their destinations have an H index of 507—just slightly above the average. The other 30 states, with an average H index of 443, send their graduates up the H scale, but not quite up to the U.S. mean. Their average destination score is 495. This is consistent with the low positive correlation of +0.25 between the H index of the state of origin and the average destination index of those who leave their states of PhD.

For these same 19 states, the data on the economic prosperity index is of interest. These 19 states have a mean E index of 515; they are above average economically, but not as outstanding as they are in higher education development. Those who leave these states after the doctorate go to states rather similar in economic status, with an average E index of 517. The other 30 states, with below-average H indices, have a lower average economic index, 491. The graduates who leave these states move very slightly up the economic scale, to states with an average E index of 495—still slightly below the U.S. mean. The correlation is still positive, but very low (+0.14) between the H index of origin and the E index of destination.

The relationship between the economic index of state of origin and of state of destination turns out to be of greater interest. The results are depicted in Table 17, in which the states are arranged in descending order of E index, and graphically in Figure 25. The correlation here is rather high, +0.76. This means that, although there is the familiar regression toward the general mean, it is much less than on the higher education scale. Those from the most prosperous states of PhD must move down the E scale, but resist going to the less prosperous states for employment. Those who take their PhD's in the less prosperous states tend to move up the economic scale, but, on the average, do not succeed in moving very far. As shown in Table 17, those who leave all of the states with E indices above 580 go, on the average, to less prosperous states, but their destination average is never below the U.S. mean. On the other hand, all of the states with E indices below 557 send their "leavers" up the economic scale (on the average, not in each individual case). In general,

TABLE 17

Mean Movement Up or Down Economic Index Scale of Those Who Leave State of PhD for Post-Phd Employment

States in Order of E Index	Economic Prosperity Index of States of PhD Origin	Mean Economic Index of Destination of "Leevers"	Mean Movement
1 D.C.	725	555	−170
2 Connecticut	699	578	−121
3 Delaware	662	579	− 83
4 New Jersey	660	576	− 84
5 Illinois	659	553	−106
6 New York	650	577	− 73
7 Massachusetts	609	585	− 24
8 Michigan	598	557	− 41
9 California	596	558	− 38
10 Ohio	586	549	− 37
11 Rhode Island	580	586	+ 6
12 Nevada	579	500	− 79
13 Indiana	574	550	− 24
14 Pennsylvania	565	580	+ 15
15 Washington	559	548	− 11
16 Wisconsin	557	554	− 3
17 Maryland	555	583	+ 28
18 New Hampshire	531	561	+ 30
19 Missouri	530	536	+ 6
20 Oregon	528	548	+ 20
21 Iowa	519	540	+ 21
22 Minnesota	506	555	+ 49
23 Nebraska	502	532	+ 30
24 Kansas	501	527	+ 26
25 Wyoming	496	504	+ 8
26 Colorado	492	527	+ 35
27 Montana	475	525	+ 50
28 Vermont	474	598	+124
29 Maine	457	558	+101
30 Texas	455	503	+ 48
31 Virginia	450	518	+ 68
32 Idaho	438	547	+109
33 Utah	431	539	+108
34 Oklahoma	426	484	+ 58
35 Georgia	425	476	+ 51
36 North Carolina	423	505	+ 82
37 West Virginia	417	528	+111
38 South Dakota	413	511	+ 98
39 Tennessee	410	485	+ 75
40 Kentucky	408	513	+105
41 North Dakota	402	525	+123
42 Florida	400	495	+ 95
43 Arizona	399	535	+136
44 South Carolina	390	470	+ 80
45 Louisiana	386	487	+101

TABLE 17

Mean Movement Up or Down Economic Index Scale of Those Who Leave State of PhD for Post-Phd Employment–Continued

States in Order of E Index	Economic Prosperity Index of States of PhD Origin	Mean Economic Index of Destination of "Leavers"	Mean Movement
46 Alabama	379	432	+ 53
47 Arkansas	366	464	+ 98
48 New Mexico	357	527	+170
49 Mississippi	333	432	+ 99

the lower the state's E index, the greater the relative economic improvement; this is less true of the states of the deep South than of less prosperous states elsewhere. Most of the movement, as was noted earlier in the chapter, is to states not geographically remote. There is a strong regional differentiation in economic prosperity, and this works to raise the correlation between E indices of states of origin and states of destination.

The impact of geography on the tendency to move toward the U.S. mean on these two indices is shown quite strikingly in Figure 26. Here the economic index of state of destination is correlated with the higher education index of state of destination. It is immediately apparent that the regression toward the mean is much greater on the H index; the states do not spread out very far above and below the mean of 500 on this index. But they do spread rather widely on the E index, which is shown on the horizontal axis. Even more striking, however, is the resulting geographic clustering on this "pseudomap." These clusters are not quite the same as the census regions; the nine regions are here reduced to five, as follows: (1) the entire eastern seaboard including New England, Middle Atlantic, and the South Atlantic states of Delaware, Maryland, and the District of Columbia; (2) the South: the rest of the South Atlantic states, and East and West South Central states as a single group; (3) the Rocky Mountain states and the plains states of North and South Dakota, Nebraska, and Kansas; (4) a truncated "Midwest" group including Ohio, Indiana, Illinois, Michigan, Minnesota, Iowa, Missouri, Wisconsin; and (5) the original three Pacific Coast states, Washington, Oregon, and California. In short, with almost no "gerrymandering," these groups fall into nonoverlapping clusters on the economic–higher education destination pseudomap.

The most interesting feature of Figure 26, as compared to the original economic–higher education pseudomap of Figure 21, is that, while the size of the state-to-state differences is drastically reduced, the geographic separation is sharpened. In general, on the indices of the states as origins, the same general groups are found in Figure 21; without "gerrymandering," however, it is not possible (as it is with Figure 26) to separate them into nonoverlapping groups. It is clearly the economic axis much more than the higher education axis that differentiates the geographic clusters shown in Figure 26.

There are a number of other interesting possibilities for discovering and

FIGURE 25

Relation of mean economic prosperity of destinations of "movers" to prosperity of state of PhD origin.

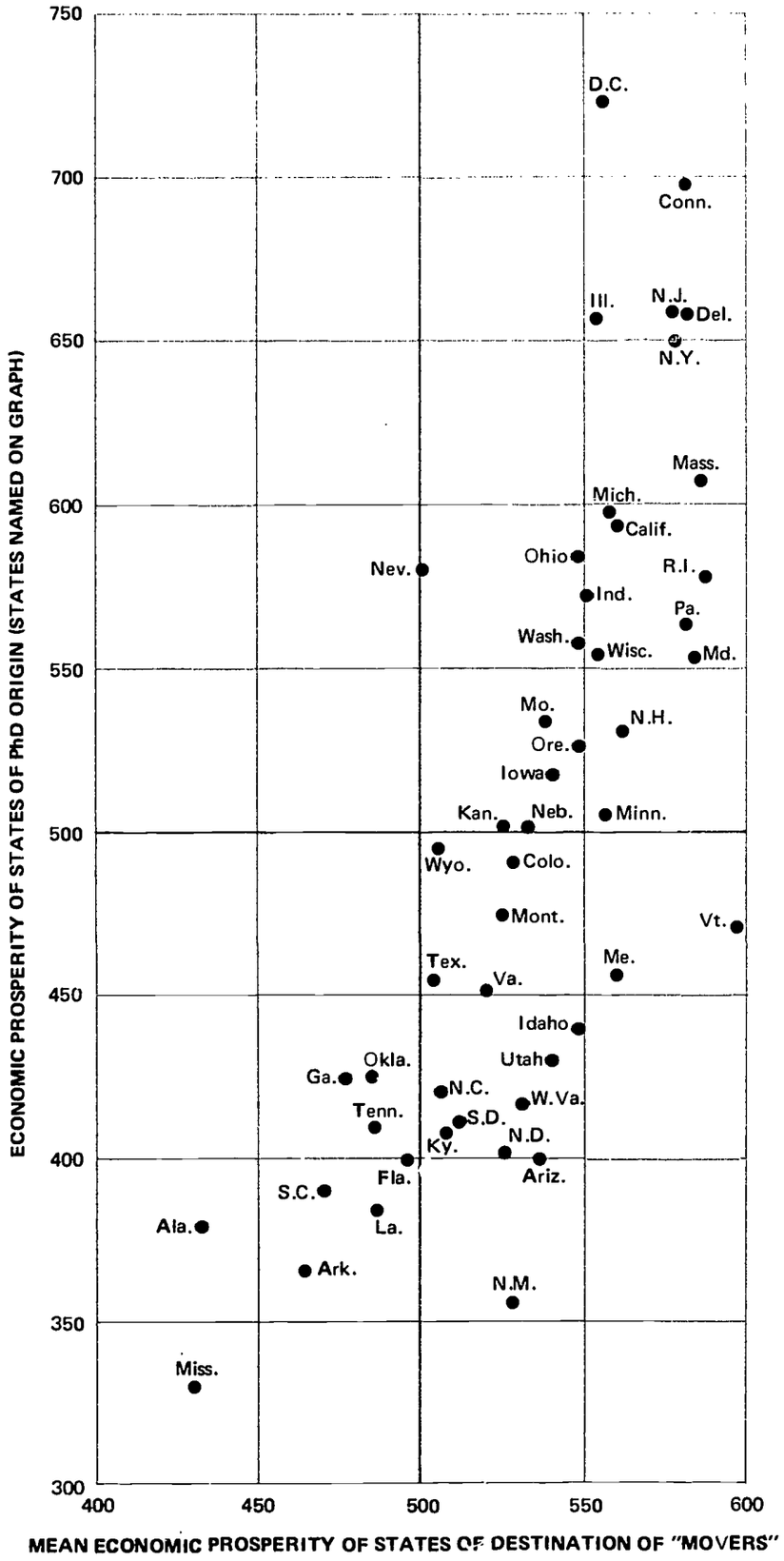
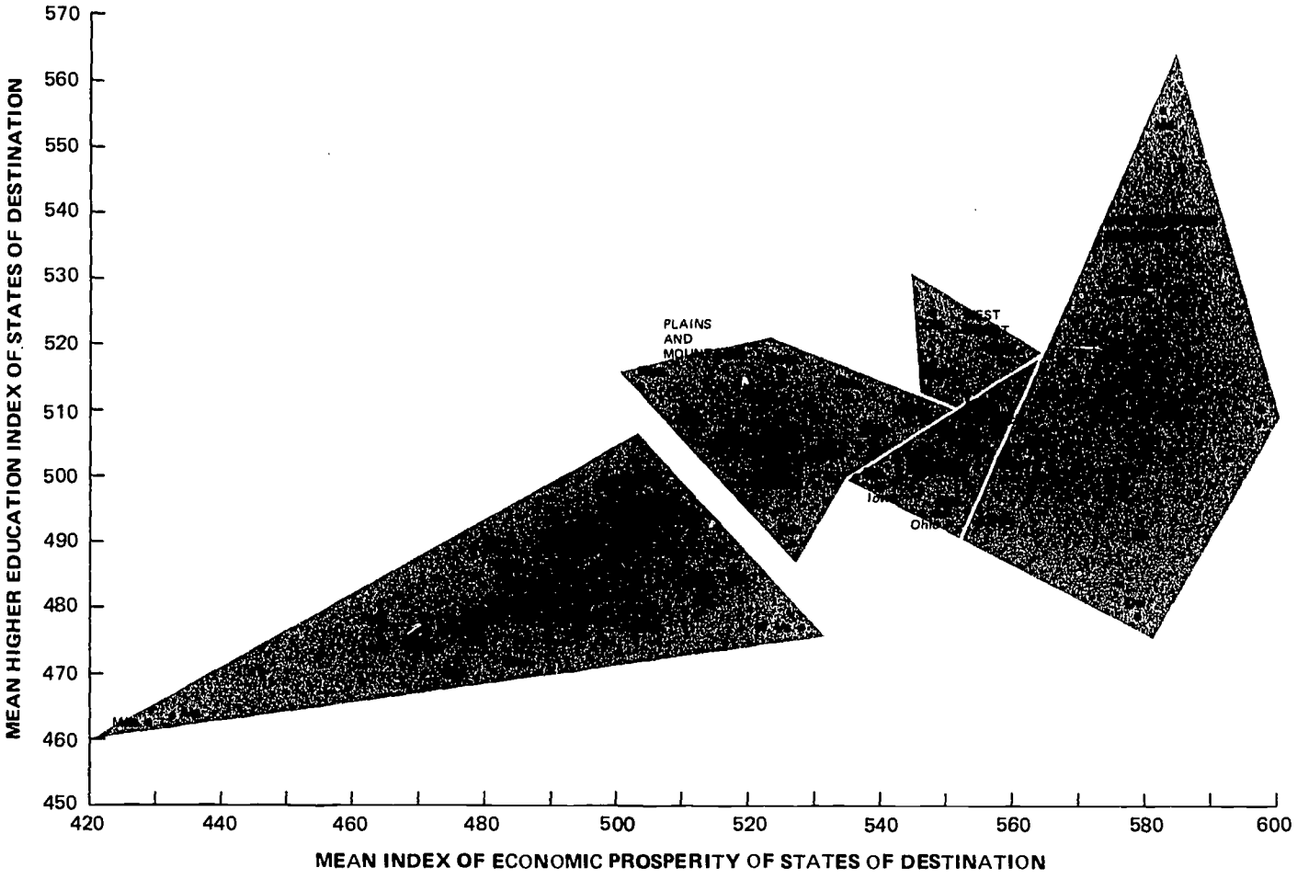


FIGURE 26

Mean E and H indices of destinations of those who move after the PhD, by state of origin. (Data from Table 16.)



interpreting the movements of these people, both prior to and after the PhD. However, space limitations forbid exploring all of these possibilities here. The interested reader is referred to Appendix D, which gives extensive tables on percentages of those moving across state lines at each career stage. Appendix H provides data on the results of these movements in terms of geographic distance, both east–west and north–south, and in terms of change in all three state indices associated with the geographic movement. Appendix I gives additional information about the personal characteristics of people in various migration streams, including both internal migration within the United States, and across national lines. Appendix J describes a kind of "cumulative inertia" that apparently has a pervasive effect on tendency to migrate.

CHAPTER V MOBILITY AFTER THE PhD

Up to this point, we have been concerned primarily with geographic mobility prior to doctorate attainment and expected geographic location on the first post-PhD job. The question naturally rises: How accurate is that statement of expectation? Do people go to the locations they state as expectations? If so, for how far into the future is this statement of expectations valid? This chapter will seek answers to these questions, and will also examine some other kinds of post-PhD mobility—across the lines of the academic disciplines, employer categories, and such types of work activity as teaching, research, and administration.

The means of post-PhD follow-up chosen for this study imposed certain limitations on the data. To avoid the harrassment of these people with yet another questionnaire, recourse was had to data already collected for a different purpose and maintained by the National Science Foundation as the National Register of Scientific and Technical Personnel. This file is renewed every 2 years and contains a wealth of data about the nation's scientists and people in certain other selected specialties. An understanding of this file—its method of data collection and the limits of the disciplinary coverage—is essential to an adequate evaluation of the data derived by using it as a source of follow-up information on PhD's.

The National Register includes people of all degree levels in contrast to the Doctorate Records File, which includes only holders of third-level research degrees. The Register is maintained through the cooperation of a number of scientific and technical societies, whose membership and other affiliates are solicited every 2 years. The respondents are screened by each society according to its own standards for inclusion, and the data from all the societies constitute the National Register. Only a fraction of the data in the Register was of concern to this study: geographic location, category of employer, type of work activity performed, and field of specialization. At the time this study was initiated, the most recent data in the file were for 1966. This provided an opportunity for follow-up of the PhD cohorts of 1961 through 1965, thus giving follow-up periods ranging from 1 to 5 years after the doctorate.

The coverage of the Register is limited, as mentioned above, to certain

technical fields. The natural sciences and mathematics, psychology, and some of the social sciences are included, but the arts and humanities, education, and other professions are not. Thus, it was not to be expected that doctorate-holders in all fields would be found, except insofar as they remained in. or switched into technical fields in 1966. Within these fields, it is estimated that up to 80 percent of the personnel are included, and indications are that this percentage is higher for those holding doctorates than for those with lesser degrees. However, coverage is dependent on the voluntary cooperation of the people themselves, and any mail questionnaire method has decided limitations in response rate. The Survey of Earned Doctorates, on the other hand, utilizes questionnaires obtained through the graduate schools at the time of PhD attainment, forwarded to the Office of Scientific Personnel by the graduate deans. It is successful in getting 100 percent coverage, at least of the names, fields, and degrees of the doctorate-holders. Not all items on the questionnaire are 100 percent complete, however; new PhD's are uncertain to a degree as to their future plans at the time they complete the questionnaire. The Doctorate Survey, however, does include all fields of specialization, and in this way it contrasts with the Register. When the two files are collated, therefore, one cannot expect to obtain 100 percent follow-up of the PhD's. Some of the comparisons and contrasts in coverage are particularly important.

The National Register, as its name states, is national. Foreign citizens who live in the United States are not excluded, but it may well be expected that their response rate would not be as high as that for U.S. citizens. Many of those awarded U.S. PhD's are citizens of foreign countries and, as shown earlier in this report, substantial numbers leave the United States after graduation. They would therefore not be expected in the Register.

About 52 percent of the PhD's in the Register were in the physical sciences, about 19 percent in the biological sciences, 14 percent in psychology, and only 11 percent in the other social sciences. In the Doctorate Survey, by comparison, these percentages were 22, 17, 7, and 9 percent. Fields not included in the Register made up 45 percent of the PhD total for the 1961-1965 period. Consequently, one could not expect a high percentage of "coverage" in the Register. Women comprise only 7.3 percent of the Register respondents, as compared with 10 percent in the Doctorate Records File. For several reasons, such as changing names on marriage and leaving gainful employment to become housewives, it is difficult to follow up women from the Doctorate Records File through the National Register. It turned out, therefore, that the only satisfactory samples to follow up in this manner were male PhD's in the natural sciences, psychology, and (with partial success) other social sciences.

The percentages of recent male PhD's found in the Register varied by field, from a high of 73 percent in mathematics and physical sciences, through psychology with 70 percent and biosciences with 64 percent to the social sciences other than psychology with 48 percent. For all of these fields combined, 67 percent of the male PhD's of the period 1961–1965 were found in the 1966 National Register. The coverage by years varied somewhat, but not systematically. From 1961 to 1965 the variation was as follows: 65, 65, 67, 70, 66 percent. The general trend is upward except for the most recent cohort, where it appears that the scientific societies had not, by 1966, obtained the addresses (or the cooperation) of this youngest group to the extent they had with their slightly older colleagues.

GEOGRAPHIC MOBILITY

In the Survey of Earned Doctorates, each PhD is asked to specify his expected first post-PhD location. The state of expected location is compared with the actual location as shown by the National Register (omitting those who did not know where they would be located); the results for all 5 years combined are as given in Table 18, which shows the number expecting to be located in each state and the percentages of these actually located in the state expected. These data, unlike those of the preceding chapters, include Alaska and Hawaii. It will be noted that there are significant variations, with South Carolina having the highest "verification" rate (82 percent) followed closely by West Virginia (81 percent), Maine and Wyoming (80 percent), and Hawaii (79 percent). These are not the most sought-after locations for PhD's; it appears, therefore, that those who definitely planned to go to these states had reasons for remaining. At the other end of the "verification" scale are Nevada (52 percent), Arkansas (56 percent) with a combined total of 62 cases (and hence unreliable percentages), Maryland and the District of Columbia (63 percent each), and Florida and Wisconsin (64 percent each). The last four states had large numbers and hence reliable percentages. The data are summarized by region and time period in Table 19.

The number living in the expected state 1 year after graduation (i.e., the 1965 cohort) is high (91 percent)—a very satisfactory verification of the Doctorate Records File location. There is some regional variation: The South Atlantic region, which includes Maryland, the District of Columbia, and Florida, has the lowest "verification" rate (87.4 percent), and the Pacific region the highest (94.5 percent). After the first year, the percentage remaining in the expected first postdoctoral state declines rather rapidly, as shown in Table 19 and in Figure 27. As might be expected, there is some change in the slope of the drop-off after the first 3 post-PhD years. By the fifth year after the doctorate, only 55 percent were in the expected first post-PhD state. The average shift from first postdoctoral job to 5 years later, for the U.S. total (bottom line in Table 19) is 35.7 percent (90.9 – 55.2 percent). This corresponds very

TABLE 18

Numbers of 1961–1965 Male U.S. Citizen PhD's Expecting First Post-PhD Employment in Each State, and Percentages of These Cases Actually in the State in the 1966 National Register

State	N	%	State	N	%	State	N	%	State	N	%
Maine	45	80	Wisconsin	349	64	N. Carolina	304	65	Idaho	41	76
New Hampshire	54	65	Minnesota	275	75	S. Carolina	71	82	Wyoming	25	80
Vermont	35	74	Iowa	220	62	Georgia	137	71	Colorado	245	75
Massachusetts	807	67	Missouri	242	76	Florida	211	64	New Mexico	175	75
Rhode Island	73	63	North Dakota	31	74	Kentucky	116	68	Arizona	88	70
Connecticut	302	67	South Dakota	44	74	Tennessee	259	75	Utah	108	78
New York	1,474	78	Nebraska	71	69	Alabama	110	65	Nevada	23	52
New Jersey	666	67	Kansas	159	70	Mississippi	71	68	Washington	249	72
Pennsylvania	755	74	Delaware	171	72	Arkansas	39	56	Oregon	141	71
Ohio	623	77	Maryland	461	63	Louisiana	167	66	California	1,715	76
Indiana	335	66	D.C.	410	63	Oklahoma	162	73	Alaska	18	67
Illinois	684	69	Virginia	204	69	Texas	545	76	Hawaii	43	79
Michigan	495	68	W. Virginia	64	81	Montana	43	74			

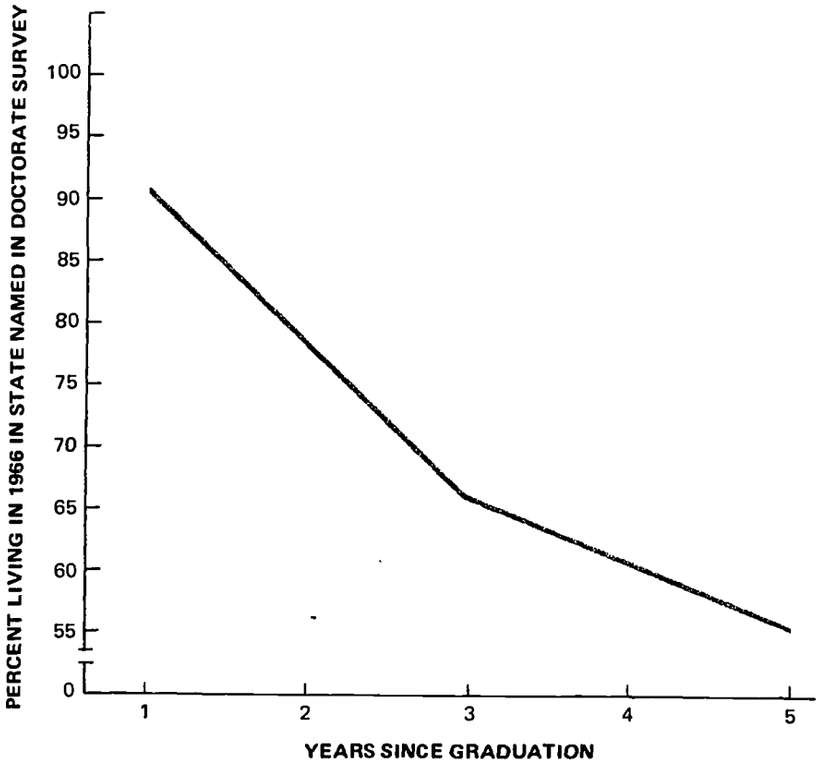
TABLE 19

Percentage of Male U.S. Citizen PhD's Living in 1966 in the Same State Expected Immediately after PhD Graduation, 1961–1965, by Geographic Region and Year

	Year of Graduation					
Region of PhD	1965	1964	1963	1962	1961	1961-65
New England	91.9	74.0	58.2	51.9	48.3	67.1
Middle Atlantic	91.0	80.2	67.2	64.8	60.5	74.3
East North Central	89.6	75.5	66.3	58.0	49.6	69.6
West North Central	90.5	78.0	63.5	57.5	57.9	71.3
South Atlantic	87.4	72.3	59.9	54.9	49.2	66.6
East South Central	93.5	75.2	72.2	56.0	48.9	70.9
West South Central	90.4	78.7	70.9	58.0	57.8	72.7
Mountain	92.0	76.8	73.9	62.5	54.4	74.3
Pacific	94.5	76.9	67.6	67.4	63.9	75.2
U.S. Total	90.9	76.5	65.8	60.0	55.2	71.4

FIGURE 27

Change in percentage residing in state of post-PhD expectation as a function of time since graduation.



well with the data found in the earlier report[1] on the changes from first postdoctoral job to 5 years later, for graduation cohorts ranging from 1935 to 1960. In the earlier study it was found that, for the group who remained always in academic employment, 65 percent did not change states of residence in the first 5 years after the PhD. For PhD's always in nonacademic employment, those remaining in the same state were 72 percent of the total, i.e., 28 percent moved. Those switching from one employer category to another were a bit more mobile, but a summary figure is not available. These data were for six graduation cohorts over the 25-year period 1935–1960. It appears that geographic shifts in the first half-decade following the doctorate have not changed much over the years. The gradual lessening of the slope of the curve in Figure 27 corresponds also with the finding of the earlier study (and expected on a common sense basis) that after the first 5 years there is a progressive settling-down, with less state-to-state migration.

1935–1960 COHORTS IN THE 1966 REGISTER

It was originally hoped that data on career lines of these earlier cohorts could be extended by collation with the 1966 Register. However, this proved infeasible: Only 48 percent of the original Career Patterns sample could be found in the 1966 Register. Examination of those so found in comparison with those not found indicated that the sample was sufficiently biased to invalidate any interpretations one might like to make regarding possible changes in the trend lines established earlier. The reasons for this bias are many, including the age of the Career Patterns cases (many in their 60's), the fact that the Register does not even attempt to cover many of the Career Patterns fields, and an unknown degree of "upward bias" in response to mail questionnaires, which may have affected differently the original Career Patterns study and the Register response in 1966.

TYPES OF EMPLOYERS

The types of employers of the 1961–1965 PhD's are summarized by field and year in Table 20. The largest single category for each field is academic. In fact, colleges and universities employ a majority of all four field groups with the single exception of the math–physical science graduates of 1961. The U.S. government employs from 7 to 12 percent of the PhD's in various fields; the percentages vary unsystematically from year to year, but the percentage patterns by field remain fairly constant: Biosciences are the highest, math and physical sciences the lowest. Business and industry employ from 4.0 percent (other social sciences) to 32.0 percent (math and physical sciences). Yearly variations in these field percentages are neither great nor systematic, except for the math and physical sciences group where the proportion in business and industry dropped regularly from 36.5 of the 1961 cohort to 28.5 percent of the 1965 cohort. This drop contrasts the trend in colleges and universities. The "all other" category is small (7.3 to 11.5 percent), except for psychology, where it is 29.9 percent for the 5-year total. Within psychology, there is substantial employment by state and local governments (10.5 percent), nonprofit organization (10.0 percent), and some by elementary and secondary schools (2.1 percent). These details are not given in Table 20, but appeared on more extensive tabulations omitted here for the sake of conciseness. Year-by-year variations within these categories appear not to be significant.

[1]Office of Scientific Personnel, *Careers of PhD's–Academic vs. Nonacademic* (Washington, D.C.: National Academy of Sciences, 1968).

TABLE 20

1966 Employer Category, by Field and PhD Year, Male U.S. Citizen PhD's in Register, in Percentages

Field and Year	Number	College or University	U.S. Government	Business Industry	Other
Mathematics and physical sciences					
1961	1,378	47.9	8.1	36.5	7.5
1962	1,562	52.0	7.7	34.2	6.1
1963	1,840	55.3	7.2	32.1	5.4
1964	1,967	55.0	6 2	31.0	7.8
1965	2,256	55.7	6.7	28.5	9.1
1961-65	9,003	53.6	7.1	32.0	7.3
Biosciences					
1961	598	67.1	12.5	10.4	10.0
1962	725	64.6	11.9	12.3	11.2
1963	698	67.9	12.6	11.9	7.6
1964	982	66.4	11.1	10.7	11.8
1965	884	63.3	14.0	8.0	14.7
1961-65	3,887	65.7	12.3	10.5	11.5
Psychology					
1961	439	51.9	9.3	5.9	32.9
1962	483	56.1	12.6	5.2	26.1
1963	547	59.6	7.5	6.2	26.7
1964	567	55.0	6.9	7.6	30.5
1965	505	52.7	8.1	5.7	33.5
1961-65	2,541	55.2	8.7	6.2	29.9
Other social sciences					
1961	342	75.1	9.6	5.8	9.5
1962	350	76.9	10.3	3.1	9.7
1963	414	81.2	7.5	4.1	7.2
1964	419	78.8	10.7	2.9	7.6
1965	466	78.3	9.0	4.1	8.6
1961-65	1,991	78.2	9.4	4.0	8.4

ANTICIPATED VS. ACTUAL TYPE OF EMPLOYER

Ignoring the time trends for the moment and looking at category totals, it is interesting to compare the 1966 employer category patterns found in the Register with the expectations, recorded at the time of graduation, regarding first post-PhD jobs by this group of male U.S. citizens. The essential data for this comparison are found in Table 21. Here, for each field, each employer category, and each graduation year we have the percentage of those whose expectations at graduation were the same as their realization in 1966. These data are limited to the people found in the Register and for whom the Register and Doctorate Records File had comparable employer categories. For those not found, the degree of agreement is, of course, unknown—though probably lower.

The bottom row of each section of Table 21 shows the 1961–1965 total number of cases in each field for each tabulated employer category. N is the number that expected the employer category given in the Doctorate Records File and is the denominator used in computing the percentages. Percentages based on fewer than 100 cases for the 5-year total could not be expected to be stable. Wherever the number is several hundred, the year-by-year percentages are fairly constant, but with the expected inverse relation to the time since graduation. Thus, of those expecting academic employment in the math

TABLE 21

Percentage, by Field and Year of PhD, of Those Whose Expected First Postdoctoral Employer Category Agreed with Actual 1966 Employer Category: 1961–1965 Male U.S. Citizens Only

Field and Year	College	Elementary–Secondary School	U.S. Govt.	State or Local Govt.	Non-profit	Business and Industry	Self-Employed
Mathematics and physical sciences							
1961	78	–	59	36	40	80	50
1962	84	–	64	56	38	84	100
1963	86	–	64	18	44	84	50
1964	87	–	67	33	53	88	–
1965	91	100	71	40	54	92	–
% 61–65	86	14	65	36	46	86	50
N 61–65[a]	4,331	7	584	50	314	2,484	10
Biosciences							
1961	84	–	55	29	44	75	–
1962	83	–	62	55	50	81	–
1963	88	–	60	30	30	82	–
1964	89	–	63	45	30	85	33
1965	90	–	72	57	60	94	–
% 61–65	87	–	63	43	44	84	20
N 61–65[a]	2,382	10	437	72	159	306	5
Psychology							
1961	79	27	37	48	27	50	60
1962	80	44	56	38	27	35	100
1963	89	41	40	50	42	59	40
1964	89	64	45	58	51	79	50
1965	89	83	71	77	69	94	75
% 61–65	86	47	49	55	44	62	61
N 61–65[a]	1,235	77	256	309	252	141	23
Social Sciences							
1961	86	17	52	–	28	67	100
1962	89	100	65	–	23	57	33
1963	93	–	54	44	39	46	100
1964	94	–	89	38	54	67	–
1965	94	100	93	86	63	68	33
% 61–65	91	35	71	45	41	59	50
N 61–65[a]	1,472	8	149	29	93	69	8

[a]Number of matching cases in Doctorate Survey, 1961–1965.

and physical science group, 91 percent were so employed a year later, 87 percent 2 years later, decreasing to 78 percent 5 years later. In the biosciences, the percentages in academe, of those expecting such employment, were 90 percent in the first year, declining to 83 percent at the fourth year, and 84 percent 5 years later. Comparable figures in psychology varied from 89 to 79 percent, and in other social science from 94 to 86 percent. On an individual case-by-case basis, then, academic employment is highly predictable from Doctorate Survey to Register, and remains so for several years.

In the nonacademic categories, the percentages are almost as good for business and industry in the physical and biological sciences. For the most part, the first-year agreement is very good wherever numbers are sufficient to reduce sampling errors. But job shifting appears to lower long-term predictability in these other employer categories.

EXPECTED WORK ACTIVITY

Graduates are also asked, on the Doctorate Survey, what their expected major work activity will be, i.e., teaching, research, administration, or professional services. It is of interest to see how well these expectations are realized. For this purpose, we have the data of Table 22. The data here are the percentages of those whose major work activity was in 1966 as expected on the Doctorate Survey for the first post-PhD job. People, who gave combinations such as "teaching and research," rather than a single major activity, are omitted. These cases are not numerous, and their major work activities in 1966 tended to be one or the other of the two anticipated. Agreement is very good between expected and actual work in research and teaching and remain so, except in psychology and the other social sciences. In psychology only, professional services are fairly well predicted; this is expected with hundreds of psychologists going into this type of activity as compared to fewer than 20 in each of the other fields. (In biosciences the 55 percent correct prediction is discounted because it is based on only 11 cases.) Administration as a work function is predicted rather erratically, except in "other social science" where agreement of expectations and realization is better for the earlier cohorts than for the more recent ones. It is probable that what has happened (apart from sampling errors) is that people who are older on receipt of the PhD (the social scientists tend to be) and who are doing administrative work at graduation tend to remain in administration. Others enter this work later, but did not expect it as a major function immediately after graduating.

TABLE 22

Percentage, by Field and Year of PhD, Whose Expected Work Activity Agreed with Actual 1966 Work Activity: 1961–1965 Male U.S. Citizens Only

Field and Work Activity	1961	1962	1963	1964	1965	1961–65	Number[a] 1961–1965
Mathematics and physical sciences							
Research & development	69	76	75	83	88	80	3,549
Teaching	76	84	79	81	85	82	1,724
Administration	33	92	71	73	82	77	51
Professional services	0	18	0	0	0	11	19
Biosciences							
Research & development	74	76	81	76	88	79	1,247
Teaching	75	80	83	82	92	84	787
Administration	50	75	67	60	83	69	29
Professional services	0	33	0	50	80	55	11
Psychology							
Research & development	47	51	63	71	72	61	508
Teaching	59	60	66	72	85	71	552
Administration	33	40	46	67	50	47	43
Professional services	53	50	62	61	66	60	645
Other social sciences							
Research & development	50	49	47	62	71	58	429
Teaching	61	73	76	78	82	76	909
Administration	100	80	71	54	46	62	39
Professional services	0	25	10	0	0	11	19

[a]Number found in Register in work activity expected in Doctorate Survey, 1961–1965 total.

TABLE 23

Changing Pattern of Work Functions over Time—1966 Register Data, by Year of PhD and Field

Field and Year	R&D	Teach	Admin.	Prof. Services and Other	Unknown
Mathematics-physical sciences					
1961	57.5	28.4	9.1	1.5	3.4
1962	56.6	31.5	7.8	1.7	2.3
1963	56.4	32.5	5.7	1.7	3.6
1964	59.3	33.1	4.5	1.3	1.9
1965	59.6	32.1	3.9	1.9	2.4
1961–65	58.0	31.6	6.0	1.7	2.7
Biosciences					
1961	55.0	33.4	7.5	1.5	2.5
1962	51.8	31.7	9.4	3.3	4.0
1963	50.0	39.3	5.3	2.5	2.9
1964	50.1	33.7	9.2	3.2	3.8
1965	48.0	39.6	4.9	4.4	3.1
1961–65	51.0	35.5	7.3	3.0	3.3
Psychology					
1961	23.0	31.4	14.6	28.3	2.7
1962	26.4	31.5	13.9	26.4	1.9
1963	31.4	31.4	9.6	26.0	1.6
1964	26.8	28.6	11.0	32.6	1.0
1965	25.7	32.8	10.5	30.2	0.9
1961–65	26.7	31.1	11.8	28.7	1.6
Social science					
1961	26.6	52.3	14.3	4.7	2.0
1962	27.5	50.6	14.5	3.9	3.6
1963	25.5	56.0	11.3	4.8	2.5
1964	30.1	54.7	8.1	2.7	4.4
1965	31.7	55.2	7.2	4.2	1.7
1961–65	28.5	54.0	10.7	4.0	2.8

DISTRIBUTIONS AND TRENDS IN WORK ACTIVITY

Apart from the extent to which work function expectations agree with later realization, the realities themselves are of some interest. How do these people distribute themselves across various types of activity, and how does this vary by field and by time period? The general picture is presented by Table 23, which shows the percentage of those PhD's found in the Register whose major work activity was given as research and development, teaching, administration, or some other function. The data are given by graduation year for each of the four general fields used in this chapter.

The cohort-to-cohort changes in work activity are generally not very great, and trends are, for the most part, a bit uncertain. This is not unexpected over such a short time span, of course. Yet, the trends that are found are worth noting and are generally in directions expected on the basis of other data and general experience. The most consistent trend is found in administrative functions: They increase rather regularly with time since graduation. In the physical sciences, there is a steady increase from 3.9 percent for the latest cohort

(1965) to 9.1 percent for the earliest (1961). In the biosciences the trend is irregular but generally upward from 4.9 to 7.5 percent over the same period. In psychology it rises irregularly: 10.5 percent for 1965 and 14.6 percent for 1961. The other social sciences show a more steady increase, from 7.2 to 14.3 percent. The field variations here are correlated with field variations in chronological age: the higher the average age, the more administrative activity.

The research and development variations are less clear-cut. There is a slight, but not very reliable, down-trend in the math, physical science, psychology, and social science fields, and a fairly steady upward trend in the biosciences. Teaching generally decreases with time since graduation, but again, the trends are irregular.

FIELD-SWITCHING

The first Career Patterns report, *Profiles of PhD's in the Sciences*, showed that field-switching from field of doctorate specialization to later work was not extensive, even over a period of many years. More detailed short-term data are provided by the present analysis, regarding the later graduates. Table 24 shows the percentage of graduates in each of seven fields who remained in those fields from 1 to 5 years following the doctorate, as shown by the National Register in 1966. As in the previous tables, only the male PhD's are involved.

The minimum field retention rate in Table 24 is 85.2 percent (the rate for chemistry in 1961); thus the maximum rate of field switching over the first 5 years after graduation was less than 15 percent (complement of 85.2). The over-all average switch-rate was 7.4 percent, and in all fields but chemistry and "other social sciences" the switch-rate was always less than 9 percent, even 5 years after graduation. The general tendency is for people to drift out of their general field only very gradually, the over-all switch-rate being approximately 2¼ percent per year. (2.24 percent per year compounded = 7.4 percent for 3 years.)

In mathematics, the average field retention rate (complement of switch-rate) was 95.3 percent. Of those who left mathematics, 3.2 percent went into physics; the other 1.5 percent were distributed across several fields, none of which got as much as 1 percent of the mathematicians. These data (fields to which they switched) are not in the table. In physics, the field retention rate

TABLE 24

Field Retention Rates from Graduation to 1966 Employment for Seven Science Fields, Male 1961-1965 PhD's

Doctorate Record Field	1961	1962	1963	1964	1965	1961-65
Mathematics	91.8	97.9	95.1	95.4	95.6	95.3
Physics	93.8	93.6	94.9	95.5	94.3	94.5
Chemistry	85.2	86.2	88.0	88.6	89.1	87.6
Earth science	91.8	92.8	95.0	96.8	98.8	95.3
Bioscience	93.8	94.0	94.0	94.5	92.3	93.7
Psychology	93.0	93.3	92.1	95.4	95.5	93.7
Other social science	86.8	87.0	89.8	87.4	87.5	87.8
Average of 7 fields	**90.9**	**92.1**	**92.7**	**93.4**	**93.0**	**92.6**

TABLE 25

Numbers of Male U.S. Citizens Switching into, out of, and within Bioscience Subfields from Graduation (1961–1965) to 1966 Register Employment Field

Field of PhD	Total N at PhD	Field of Employment, 1966 Register												PhD to 1966 Employment	
		Misc. Biol.	Bio-Chem.	Gen-etics	Pharm-acol.	Phys-iol.	Micro-biol.	Med. Sci.	Bot-any	Agr.	Zool.	Phys. Sci.	Other Nonbiol.	Gain or Loss in Field Total (%)	Retention Rate (%)
Misc. biology	311	**140**	15	4	2	11	4	17	8	15	32	61	2	+160	45
Biochemistry	780	18	**673**	2	14	19	11	5	2	0	1	33	2	+ 46	86
Genetics	177	2	2	**138**	0	2	1	0	3	23	1	5	0	+ 42	78
Pharmacology	210	2	11	0	**181**	10	2	2	0	0	0	1	1	+ 16	86
Physiology	711	141	67	4	10	**301**	11	15	94	10	43	7	8	+ 1	42
Microbiology	440	10	37	18	4	51	**292**	8	3	0	12	4	1	- 17	66
Medical sciences	162	20	3	0	13	21	17	**44**	1	0	3	34	6	- 21	27
Botany	493	55	16	7	0	167	8	2	**204**	13	3	15	3	- 26	41
Agriculture	850	42	137	55	2	41	7	5	41	**426**	8	62	24	- 40	50
Zoology	739	329	18	18	1	75	7	14	1	10	**235**	19	12	- 52	32
Physical sciences	—	31	158	2	5	5	3	5	3	8	3	—	—	—	—
Other nonbiology	—	18	2	4	12	15	1	11	4	5	12	—	—	—	—
Total employed, 1966		**808**	**1,139**	**252**	**244**	**718**	**364**	**128**	**364**	**510**	**353**	—	—	—	—

averaged 94.5 percent. Of those who left, 1.2 percent went into mathematics, 2.2 percent into earth sciences, and 1.1 percent into engineering; the remaining were scattered, less than 1 percent to a field. The lowest field retention rate was in chemistry, which averaged 87.6 percent for the five graduation cohorts. Of those that left chemistry, 6.0 percent entered physics, 5.1 percent entered biology; and the rest were scattered with less than 1 percent per field. Earth sciences equaled mathematics in field retention rate at 95.3 percent for the average of the 5 years. Of those that left, 1.3 percent went into physics, 1.3 percent into biosciences, and the rest scattered. Within the biosciences, the retention rate was 93.7 percent with 1.3 percent each into math and earth sciences and 1.6 percent into chemistry. Psychology also had a 93.7 percent over-all retention rate; 2.8 percent entered mathematics, and 1.4 percent into other social sciences. In the "other social sciences" 87.8 percent remained within this general rubric, a field grouping that is not well covered by the Register. Of those who left, 3.5 percent went into psychology, 2.6 percent into mathematics, and the rest were scattered among various fields, less than 1 percent per field.

BIOSCIENCE SUBFIELD SWITCHING

The switching of major fields, as shown in Table 24, is a rather steady process, becoming progressive over time. This contrasts the year-to-year switching within the bioscience fields (not shown here), which is at a much higher rate but does not vary systematically with time since the PhD. Apparently a considerable amount of "turbulence" is to be expected within bioscience subfields in the early career stages; the number remaining in their PhD fields from graduation until 1966 is approximately the same for all graduation cohorts, 1961 through 1965. This subfield retention rate varies greatly from field to field (and these differences are stable across years), but the actual percentages are rather unreliable because of the small numbers of cases. The switch-rate, however, within these subfields is far higher than that reported across major field boundaries in Table 24; also, it is much higher than that reported in *Careers of PhD's: Academic vs. Nonacademic*, in which the same bioscience subfields were used. The difference is probably due to the fact that the earlier report was a more long-term one, reporting successive 5-year periods following graduation, thus dealing with careers at a more advanced and stabilized period, in contrast to the first post-PhD years.

The switches within the bioscience fields, from PhD graduation to 1966 employment, are shown in Table 25. All graduation years are combined here to obtain sufficiently reliable data to show subfield differences; it is assumed that all are similarly affected by the varying time lapse since the doctorate for the 5 graduation years, 1961–1965. Ten fields within the biosciences are shown in Table 25; the physical sciences are here combined into a single field, and all other science and nonscience fields are grouped into another field labeled "all other." The switches into and out of each field are shown: Fields of PhD are listed vertically at the left; the first column gives the number in each field at graduation; the diagonal indicates the number remaining in the field, and the other numbers in each row show the switches into the various other fields. The fields of 1966 employment are listed across the top of the table; the contributions to each of these fields from each of the others are observed by reading down the column to the 1966 total field size at the bottom.

TABLE 26

Percentage of Male U.S. Citizens Switching into, out of, and within Bioscience Subfields from Graduation (1961–1965) to 1966 Register Employment Field

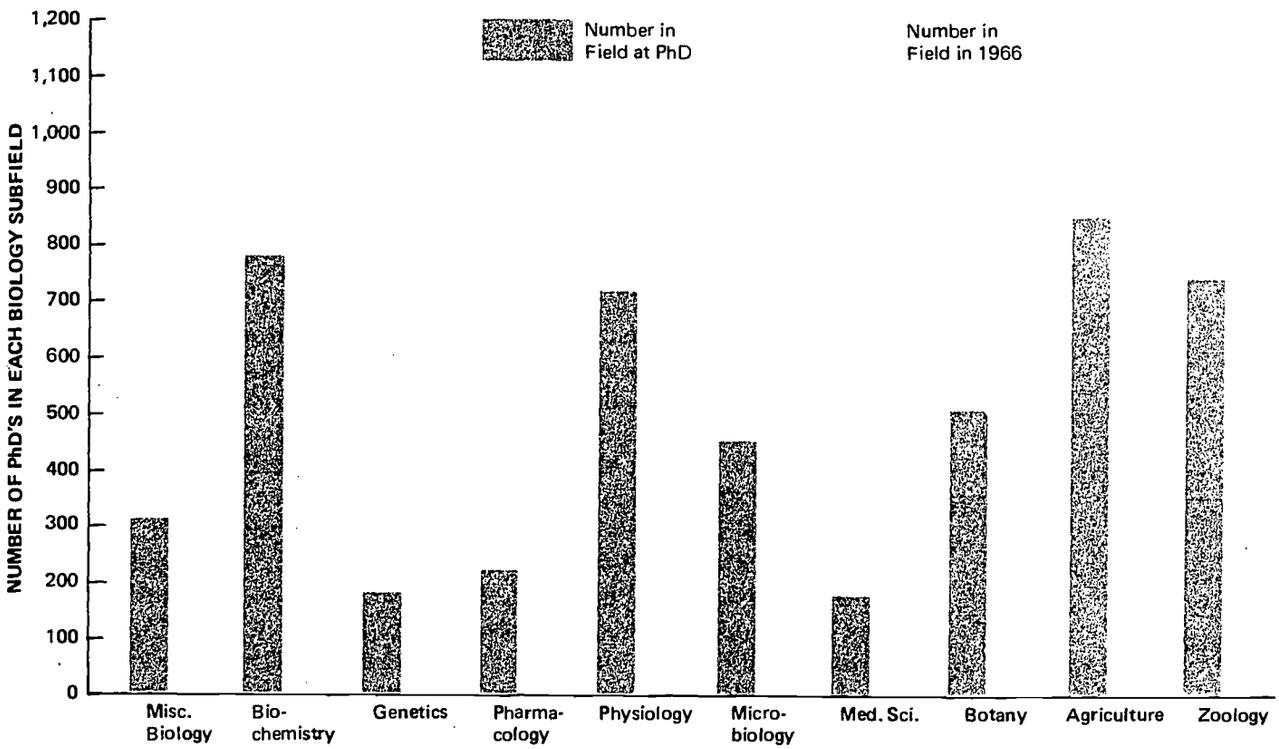
Field of PhD		Field of Register, 1966												
		Misc. Biol.	Bio-chem.	Genetics	Pharmacol.	Physiol.	Microbiol.	Med. Sci.	Bot.	Agr.	Zool.	Phy. Sci.	All Other	Row Total
Misc. biology	H%	**45.0**	4.8	1.3	0.6	3.5	1.3	5.5	2.6	4.8	10.3	19.6	0.6	100.0
	V%	**17.3**	1.3	1.6	0.8	1.5	1.1	13.3	2.2	2.9	9.1	0.6		
Biochemistry	H%	2.3	**86.3**	0.3	1.8	2.4	1.4	0.6	0.3		0.1	4.2	0.3	100.0
	V%	2.2	**59.1**	0.8	5.7	2.6	3.0	3.9	0.5		0.3	0.3		
Genetics	H%	1.1	1.1	**78.0**		1.1	0.6		1.7	13.0	0.6	2.8		100.0
	V%	0.2	0.2	**54.8**		0.3	0.3		0.8	4.5	0.3			
Pharmacology	H%	1.0	5.2		**86.2**	4.8	1.0	1.0				0.5	0.5	100.0
	V%	0.2	1.0		**74.2**	1.4	0.5	1.6						
Physiology	H%	19.8	9.4	0.6	1.4	**42.3**	1.5	2.1	13.2	1.4	6.0	1.0	1.1	100.0
	V%	17.5	5.9	1.6	4.1	**41.9**	3.0	11.7	25.8	2.0	12.2	0.1	0.1	
Microbiology	H%	2.3	8.4	4.1	0.9	11.6	**66.4**	1.8	0.7		2.7	0.9	0.2	100.0
	V%	1.2	3.2	7.1	1.6	7.1	**80.2**	6.3	0.8		3.4			
Medical sciences	H%	**12.3**	1.9		8.0	13.0	10.5	**27.2**	0.6		1.9	21.0	3.7	100.0
	V%	2.5	0.3		5.3	2.9	4.7	**34.4**	0.3		0.8	0.3	0.1	
Botany	H%	11.2	3.2	1.4		33.9	1.6	0.4	**41.4**	2.6	0.6	3.0	0.6	100.0
	V%	6.8	1.4	2.8		23.3	2.2	1.6	**56.0**	2.5	0.8	0.1	0.1	
Agriculture	H%	4.9	16.1	6.5	0.2	4.8	0.8	0.6	4.8	**50.1**	0.9	7.3	2.8	100.0
	V%	5.2	12.0	21.8	0.8	5.7	1.9	3.9	11.3	**83.5**	2.3	0.6	0.4	
Zoology	H%	44.5	2.4	2.4	0.1	10.1	0.9	1.9	0.1	1.4	**31.8**	2.6	1.6	100.0
	V%	40.7	1.6	7.1	0.4	10.4	1.9	10.9	0.3	2.0	**66.6**	0.2	0.2	
Physical sciences	H%	0.3	1.6							0.1		97.4	0.4	100.0
	V%	3.8	13.9	0.8	2.0	0.7	0.8	3.9	0.8	1.6	0.8	94.2	0.7	
All other	H%	0.3		0.1	0.2	0.2		0.2	0.1	0.1	0.2	5.7	92.9	100.0
	V%	2.2	0.2	1.6	4.9	2.1	0.3	8.6	1.1	1.0	3.4	3.4	98.3	
Column total (vertical %)		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

The raw numbers in Table 25 may be interpreted by converting them to percentages and by graphing them. Table 26 gives the percentages for a field both as a donor to other fields and as a recipient from the other fields. In Table 26 the upper figure in each cell represents the percentage of all the doctorates granted in a given row, who then leave to enter the fields shown in the columns. The lower percentage is based on the number of people in the Register (columns) and indicates the proportion of the registrants in that column who have entered from each of the PhD fields (rows). The diagonal entries, of course, treat those who do not change as percentages of their PhD field (upper figure)—same as the retention rate shown in Table 25—and of the Register field (lower figure).

The arrangement of the bioscience subfields in Tables 25 and 26 and in Figure 28 is determined by the relative rate of growth or decline from graduation to 1966 employment. The field that has grown the most is "miscellaneous biology," which groups a number of emerging fields and fields too small at the graduate school level to have warranted separate recognition. It includes biophysics, biostatistics, ecology, hydrobiology, and "other biology" fields not separately designated in the Doctorate Survey. This group grows from 311 at the PhD stage to 808 at the 1966 employment stage, or 160 percent. Zoology is the major contributor to this field, providing more individuals than the "miscellaneous biology" field itself (339 vs. 140); physiology

FIGURE 28

Bioscience subfields arranged in order of relative change in size from PhD to 1966 employment. (Data from Table 25.)



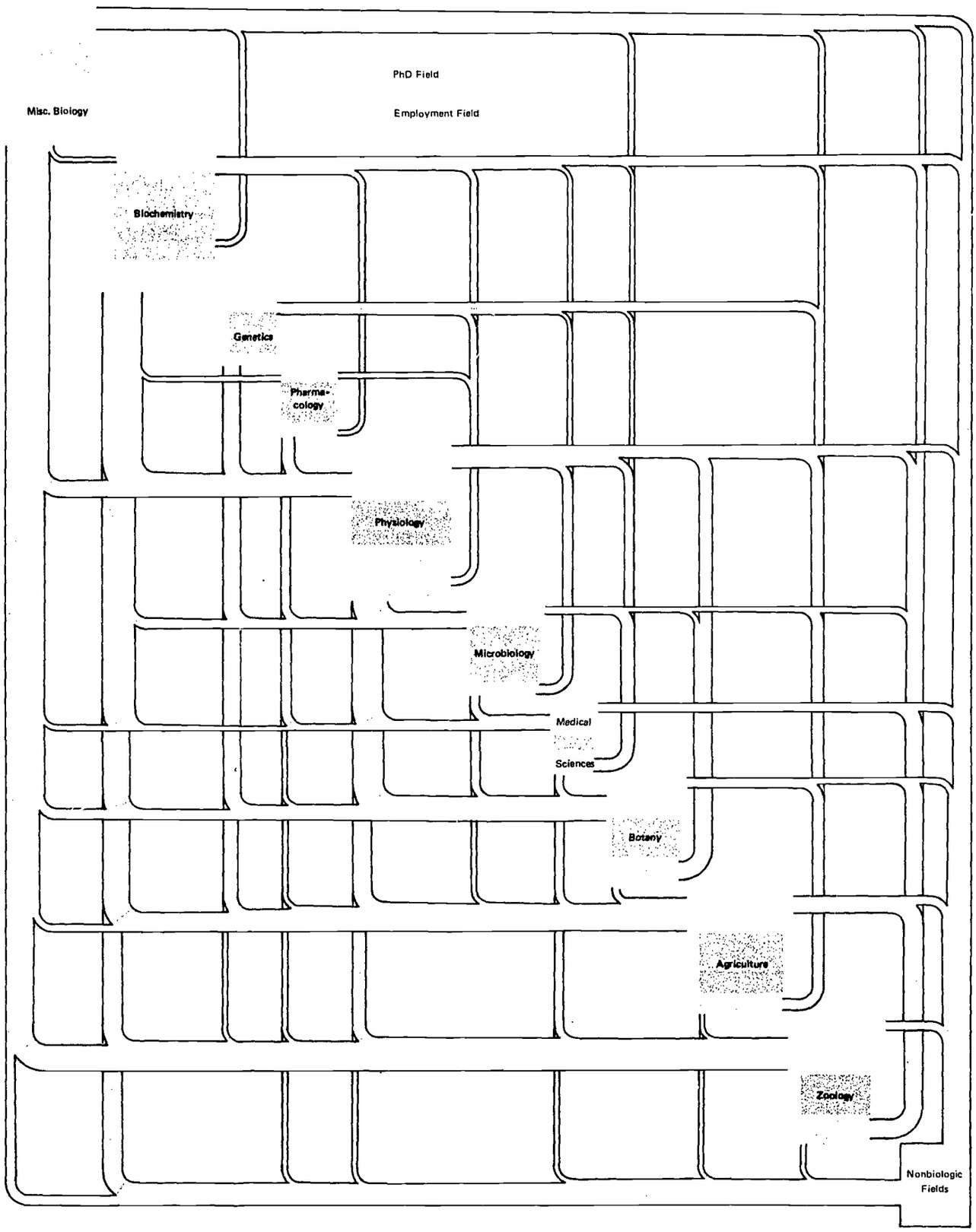
also outnumbers "miscellaneous biology" (141 vs. 140). Miscellaneous biology's gains from outside the bioscience field are substantial (31 cases from the physical sciences and 18 from all other fields), but its losses to the physical sciences are 60 cases and 2 cases to all other fields. Biochemistry is the second field in rate of growth from PhD to 1966 employment, going from 780 to 1,139; its major contributor is the physical sciences (principally chemistry) rather than any of the other biological fields. Biochemistry also retains most of its own graduate school members, 673 out of 780 or 86 percent. Genetics is the third in growth rate, increasing by 42 percent, from 177 to 252; it has a 78 percent retention rate (138/177). Pharmacology is fourth; it gains only 63 members and loses fewer (29 out of 210), and has a field retention rate of 86 percent. Physiology is notable not only for its size, but also for having a high "field turnover" rate, losing 410 or 58 percent of its PhD members and gaining back 417, for a very small net change in total field size. Microbiology retains 66 percent of its PhD's, but loses 148 and gains only 72, for a minor net field loss. The medical field group loses heavily (118 cases) to several other fields, principally the physical sciences, and gains back only 84; this group has the lowest field retention rate of all (27 percent). Botany, agriculture, and zoology all lose substantially to more highly specialized fields, and gain relatively few in return, ending up with net percentage losses of 26, 40, and 52 percent, respectively.

The net changes in field size that result from this field-switching are shown graphically in Figure 28, which displays in side-by-side vertical bars the size of each field at the PhD and employment stages. The flow patterns into and out of each field are depicted graphically in Figure 29. Here the fields are in the same orderly arrangement from the "big gainers" down to those that lose heavily at the employment level. In Figure 29, outflows are depicted by the horizontal "pipes"; inflows from other fields are shown by the vertical "pipes." The size of the pipes is made proportional to the number of people moving into or out of each field; where there were fewer than 10 people making a particular switch, no interchange is shown. Each field is represented as a PhD field (upper square) and as an employment field (lower square), with the overlapping of the squares representing field retention, i.e., those who did not switch from PhD to later employment. The area for each field at each stage is proportional to the number of people in it (and, of course, proportional to the bars in Figure 28). The flow is clockwise, i.e., out to the right and down, or out to the left and up. In Figure 29 all nonbiology fields are shown as a single field, and the "field size" is arbitrary. Some of the relative rates of interchange may be more readily observed in Figure 29 than in Table 25. For example, the limited range of outputs from pharmacology is readily observed, as also is the limited number of inputs into microbiology.

In summary, we note that switching of fields is a rather gradual process: The rate of switching major fields, as from physics to chemistry or from engineering to biology, moves about 2¼ percent of the people each year from their field of PhD to a different field of employment. In these data, chemistry had the highest rate of change, mathematics and earth sciences the lowest rates, and biology was about average. Within the bioscience field, however, shifting of subfields was much greater, particularly with the development of new fields and the tendency toward greater specialization, which takes people out of such general academic fields as agriculture, botany, or zoology.

FIGURE 29

Field-switching from PhD graduation (1961-1965) to National Register, 1966.



Among the major subfields of the biosciences, biochemistry was notable for attracting many people from other specialties.

The category of employer of the emerging PhD for the first 5 years after graduation is rather well forecast by the statement of expectation on the Survey of Earned Doctorates. The agreement in the major categories of employer declines gradually from about 90 percent for the first year after graduation to about 80 percent 5 years later. The expected first job activity is not quite as effective as a predictor of actual functions performed. Over the first 5 years after graduation, the agreement between expectation and actuality declines from slightly under 90 percent to between 50 and 70 percent in the major functional categories (teaching, research; and, in engineering and psychology, professional services). There is a gradual shift from other functions to administration as careers mature. Over the first 5 post-PhD years, however, this is not a major activity of many prople as evidenced by the range from 4 to 15 percent in the various fields.

Returning to the general theme of geographic migration, it is found that the expected state of first post-PhD job agrees well with the actual location only in the first year after graduation. Mobility is high, and the number living in the "expected state" declines from 90 percent in the first year to 55 percent 5 years later. Summing across all graduation years to obtain more stable data for state-by-state comparisons, we find that the average (about 3 years after graduation) in agreement is about 70 percent, varying from approximately 60 to as high as 80 percent. The determiners of this variation are not immediately apparent, but some of the highest rates are found in states that are low in both economic and higher education indices. This leaves for later research the delineation of the relationships between individual and institutional characteristics that may explain these differences.

CHAPTER VI SOME UNANSWERED QUESTIONS

The present study has provided some quantitative means by which the migration of PhD's may be studied, and measures of educational and economic factors related to the origins and destinations of U.S. PhD's. Migration flows have been depicted. However, many questions remain regarding the dynamic relationships of educational development and economic prosperity. To list a few:

1. We do not know the relationship between educational development and economic *growth*; the latter is negatively correlated, to a mild degree, to economic prosperity, the variable used in this report.
2. We do not have historical data showing the sequence of graduate school development and economic strength to help determine the direction of causality in the observed relationship.
3. We do not know how field variations in PhD output and deployment may be related to either economic or higher education development, although it seems quite clear that there must be differences in the impact of engineers and classicists, for example.
4. We know nothing of the quality variations in the various migration streams. These variations may be large or small, and they may be of great or only minor significance to those concerned with the support of higher education or with the employment of the products of higher education. The quantitative brain drains and brain gains are readily apparent; the qualitative variations may be very different.

APPENDIXES

APPENDIX A The Grid System

The map of the United States produced by the computer using the grid system is shown in Figure 15. The computer-produced map and grid locations derived from it were designed to accurately represent distances between locations. Because the map is rectangular, and projected on a flat surface, it does not allow for the curvature of the earth. This results in small errors of direction, particularly on the east and west coasts. In the central part of the county, errors of direction are close to zero. Because direction is represented only very generally in these analyses (movement was categorized in only eight vectors), the directional errors are not of any great significance here. Distance, on the other hand, is as accurately represented as possible.

The original grid map was produced by starting with a U.S. Geological Survey map made by the Albers equal-area projection method. This map had a scale of 1/5,000,000 or about 80 miles to the inch. A grid of 50- by 50-mile squares was laid out on this map, with the scale running from east to west and from north to south. This put the low numbers in the northeast, where PhD's are concentrated, thus tending to keep the grid-location numbers low. Although eventually little use was made of the outlying areas and most calculations confined to the conterminous states, the original zero points were set so as to include Alaska and Puerto Rico with positive numbers. These outlying areas, together with Hawaii and the Panama Canal zone, required some grid adaptations, in that it is not feasible to extend a flat grid system so far. However, numbers were derived in such a way as to maintain the distances as accurately as possible. The numbers of cases were small for the outlying areas, hence any statistical errors introduced by these adaptations were small.

It would have been possible to set up a computer system based on latitude and longitude notations and spherical trigonometry to circumvent the errors induced by projecting the curved surface of the earth on a flat map, thus preserving the accuracy of both directions and distance. However, the original location and the calculation burdens of such a system, for the numbers of cases and moves involved in this study, would have been enormous. The improvement in accuracy of direction was deemed not worth the cost. There would have been a loss, too, in comprehensibility, as it would have been necessary to rely completely on the computer's calculations, without the direct visual and common-sense checking that is possible with the grid system.

To locate institutions with sufficient accuracy (to within 10 miles in both north-south and east-west directions, i.e., to 1 digit in the 3-digit symbols used here) the original 50-mile grids were transferred from the big U.S. map to larger-scale state maps on which the institutions could be located. With the grids thus transferred, the locations were read off

for all the institutions of higher education in the Doctorate Records File, including the institutions of baccalaureate origin of these PhD's. The state centers of population, located in terms of latitude and longitude by the U.S. Bureau of Census, could be interpreted in grid location terms on the original map.

The high schools presented a more massive problem as there are 25,000 of them, over 10,000 of which have graduates represented in the present study. An approximation system was used here, less accurate than the locations of the colleges and universities, but accurate enough for statistical purposes. The approximation consisted in assuming that the high school was located at its zip code sectional center. These sectional centers are represented by the first 3 digits of the zip code; there are 549 of them in the United States. For the most part they are located in the larger population centers; for high schools in those cities there would be essentially zero error. As ascertained in previous studies, most PhD's come from high schools in such centers. The grid locations of these sectional centers were determined, as were the zip codes of the high schools. The transfer of grid locations to the high schools was thus a simple matter. For the minority of PhD's coming from high schools located outside the sectional centers, there would thus be some error of high school location, but it would be smaller by an order of magnitude than would have been the case if state centers of population had been used. The error is very seldom greater than 50 miles using this system. It is not felt that occasional errors of this magnitude would induce any errors of interpretation of statistical data in the current study. In fact, grouping errors encountered in the categories finally employed in the migration diagrams are much larger than this, but still of no statistical importance.

For locations of place of birth and of places of post-PhD employment, there was no choice. The original data were in terms of state of birth or of employment; more accurate location was not possible. In these cases, the state center of population was employed. From the standpoint of the correlation with state economic and educational characteristics, of course, this did not matter at all. From the standpoint of a migration analysis more fine-grained than that undertaken in this study, a minor degree of error would have to be allowed for. However, it seems likely that more PhD's would be employed in or near the major population concentrations than would a random sample of the population; hence, the error in location, induced by using the state center of population as an approximation, would be even smaller in this case than for the population in general. In short, the grid location system here employed had no significant errors of locations for the purposes of the present study. Errors of direction are minor and are limited to the coastal portions of the United States. They are not such as to induce errors of interpretation.

APPENDIX B Grid Locations at BA and at PhD of the Doctorate Recipients of 1920–1967, by Decade, with Tables of Regional Interchange

In the first five of the diagrams that follow (Figure B–1), the locations of the PhD's of each decade are shown on the computer-produced grid map. They are shown in "per mil" figures, that is, the number per thousand PhD's who took their doctoral degrees in each 100 × 100 mile area of the United States. The second set of diagrams (Figure B–2) shows the same people in terms of their locations at the time of their baccalaureate degrees. There are, thus, two maps for each decade: One shows the dispersion of doctoral degrees, the other the dispersion of the baccalaureate origins of these doctoral recipients. The tables that follow translate these same data into region-to-region interchanges from baccalaureate to doctoral degrees. It should be noted that the decade of the 1960's is truncated in these data; the information for the last 2 years of the decade were not available when these diagrams and tables were prepared.

In Table B-1, the raw numbers making each of the BA-to-PhD interchanges are translated into percentages. The horizontal percentages (H%) show, for each region of PhD, the proportion who earned their baccalaureate degrees in each of the nine census regions. The vertical percentages (V%) show the distribution of the regions to which the baccalaureate graduates of each region went for their PhD's. The change from decade to decade can be traced by comparing the five tables, one for each period. All of these diagrams and tables contain combined data for all doctorate fields.

FIGURE B-1

Grid locations at PhD of the PhD graduates of U.S. universities (1920–1960).

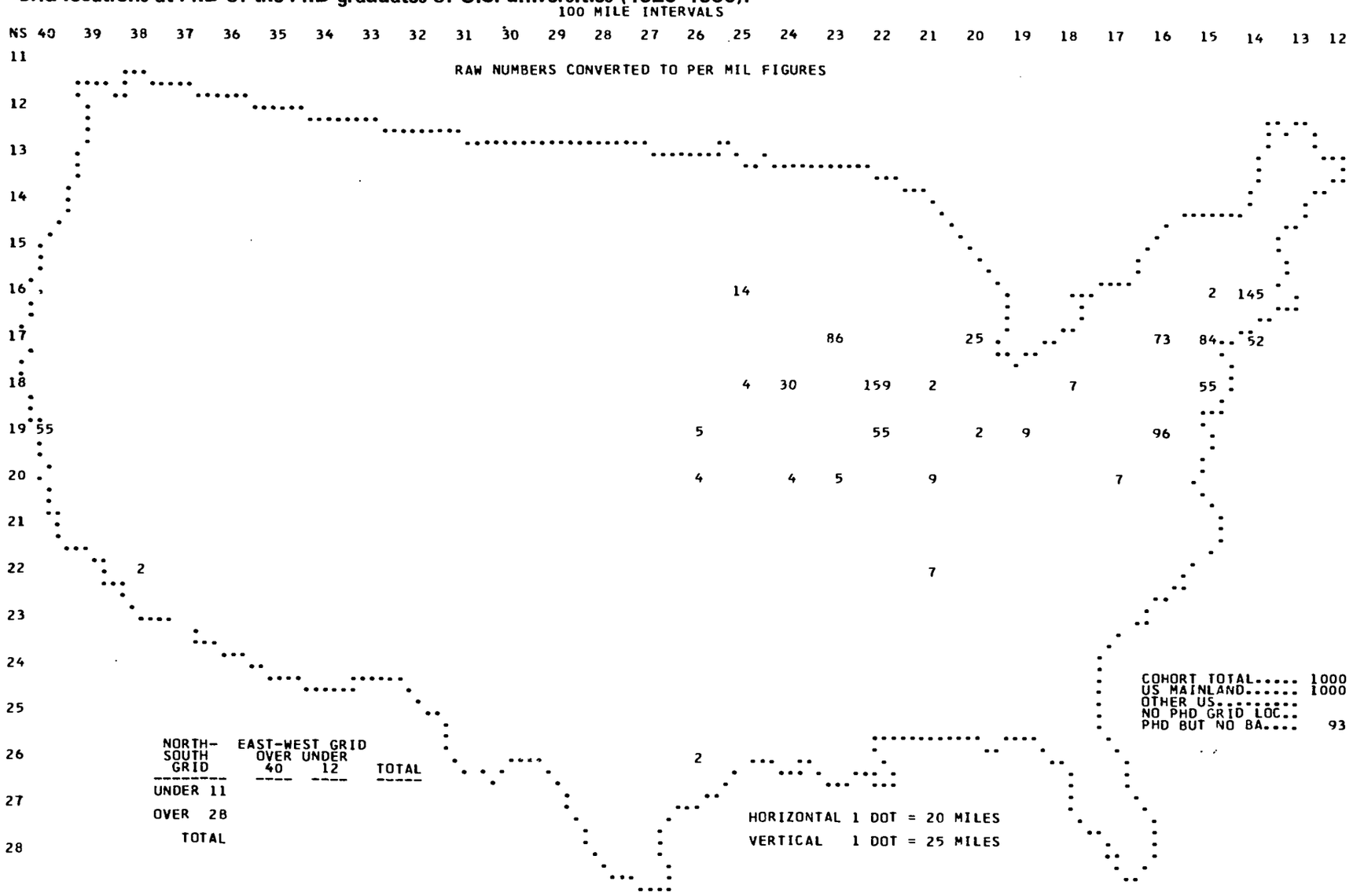


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FIGURE B-1—Continued

108

FIGURE B-1—Continued

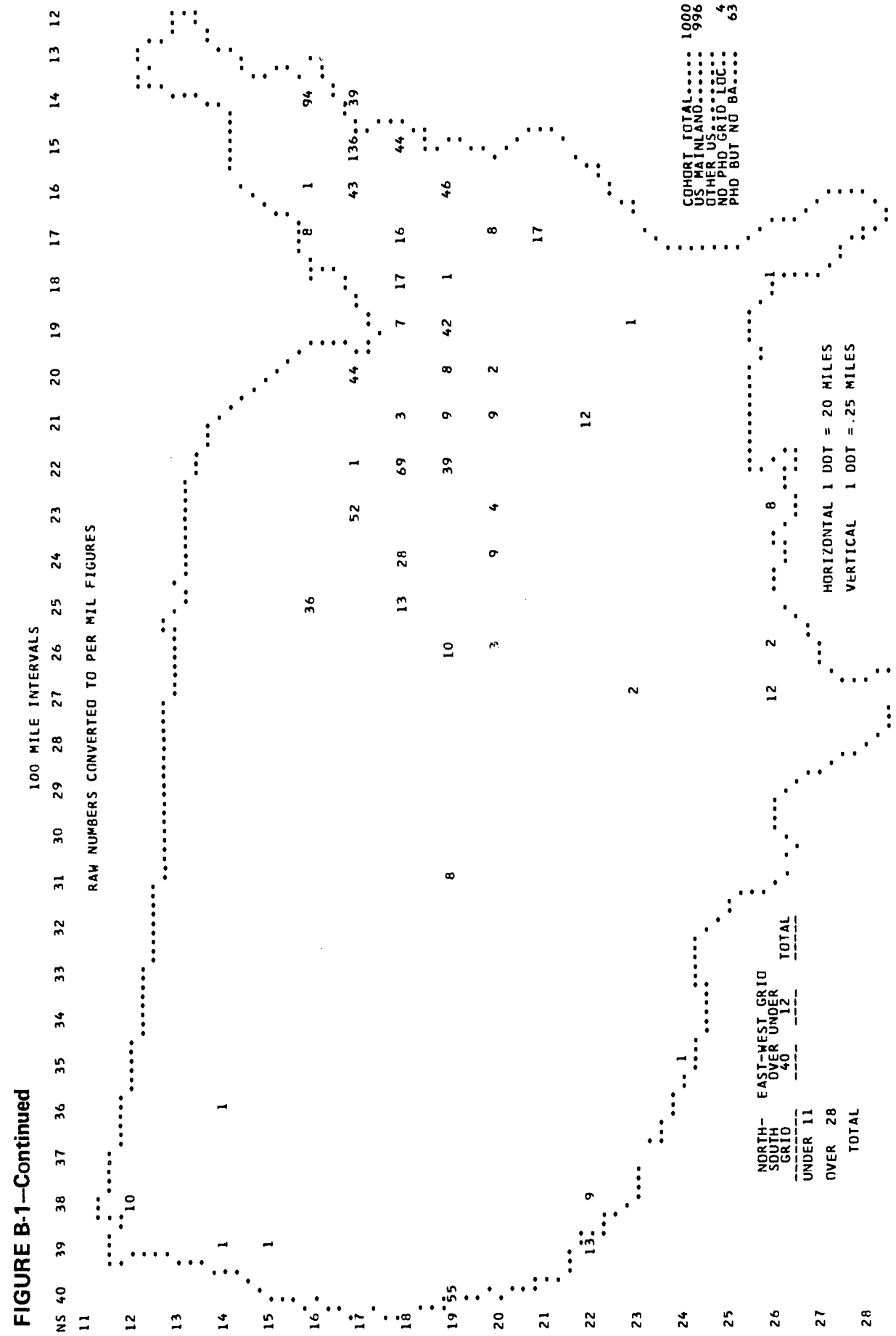


FIGURE B-1—Continued

FIGURE B-1—Continued

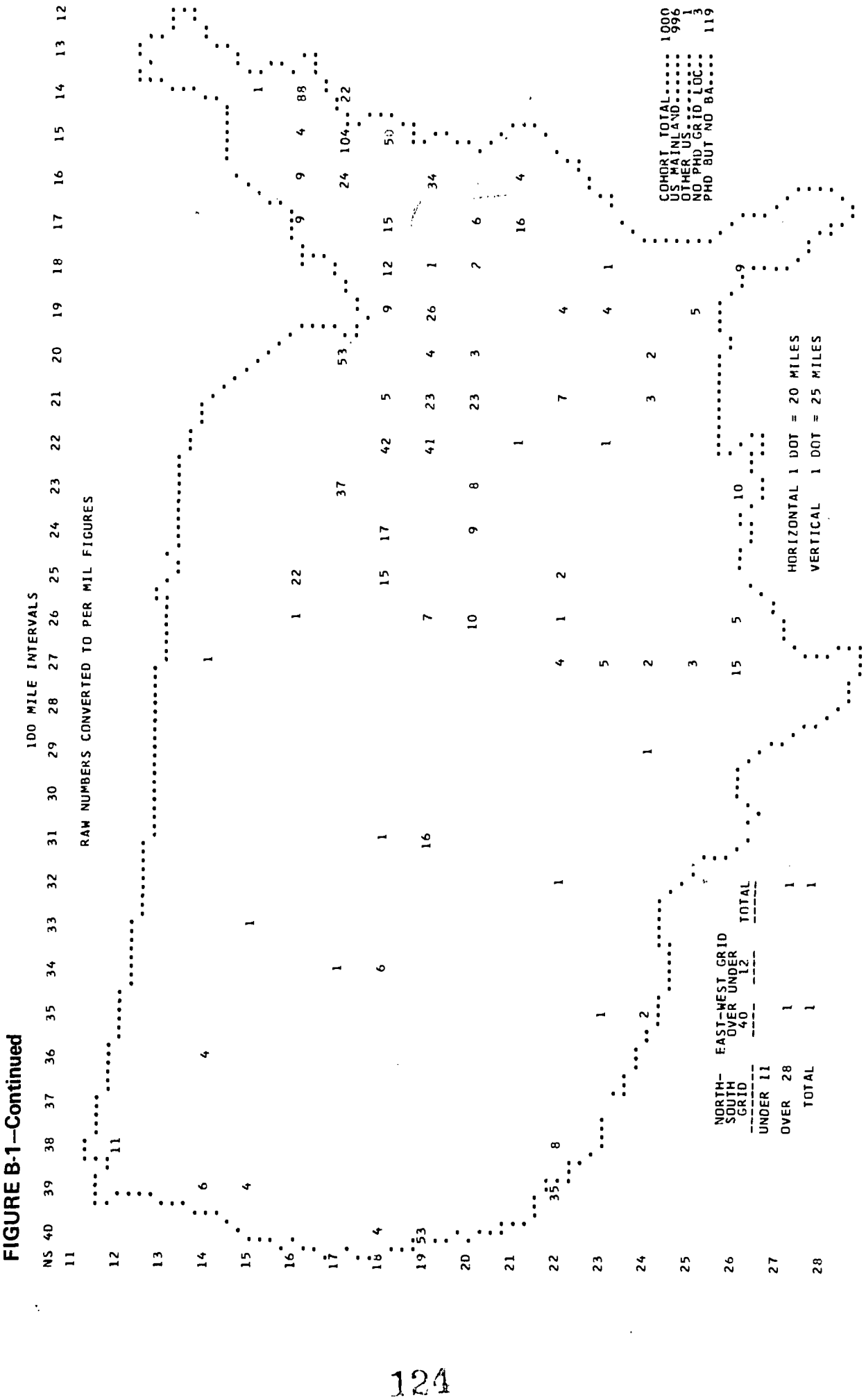


FIGURE B-2

Grid locations at BA of the PhD graduates of U.S. universities (1920–1960).

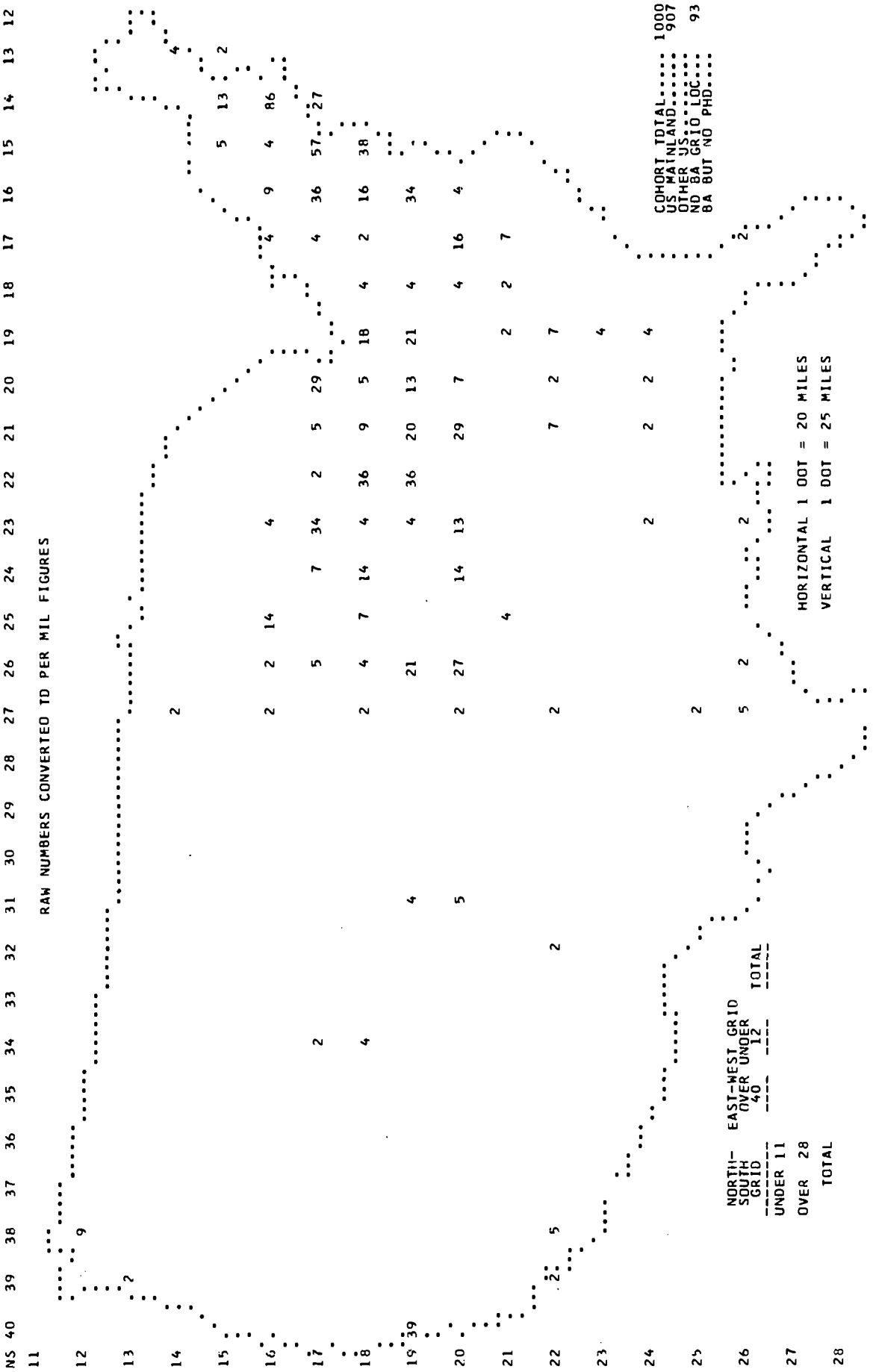


FIGURE B-2—Continued

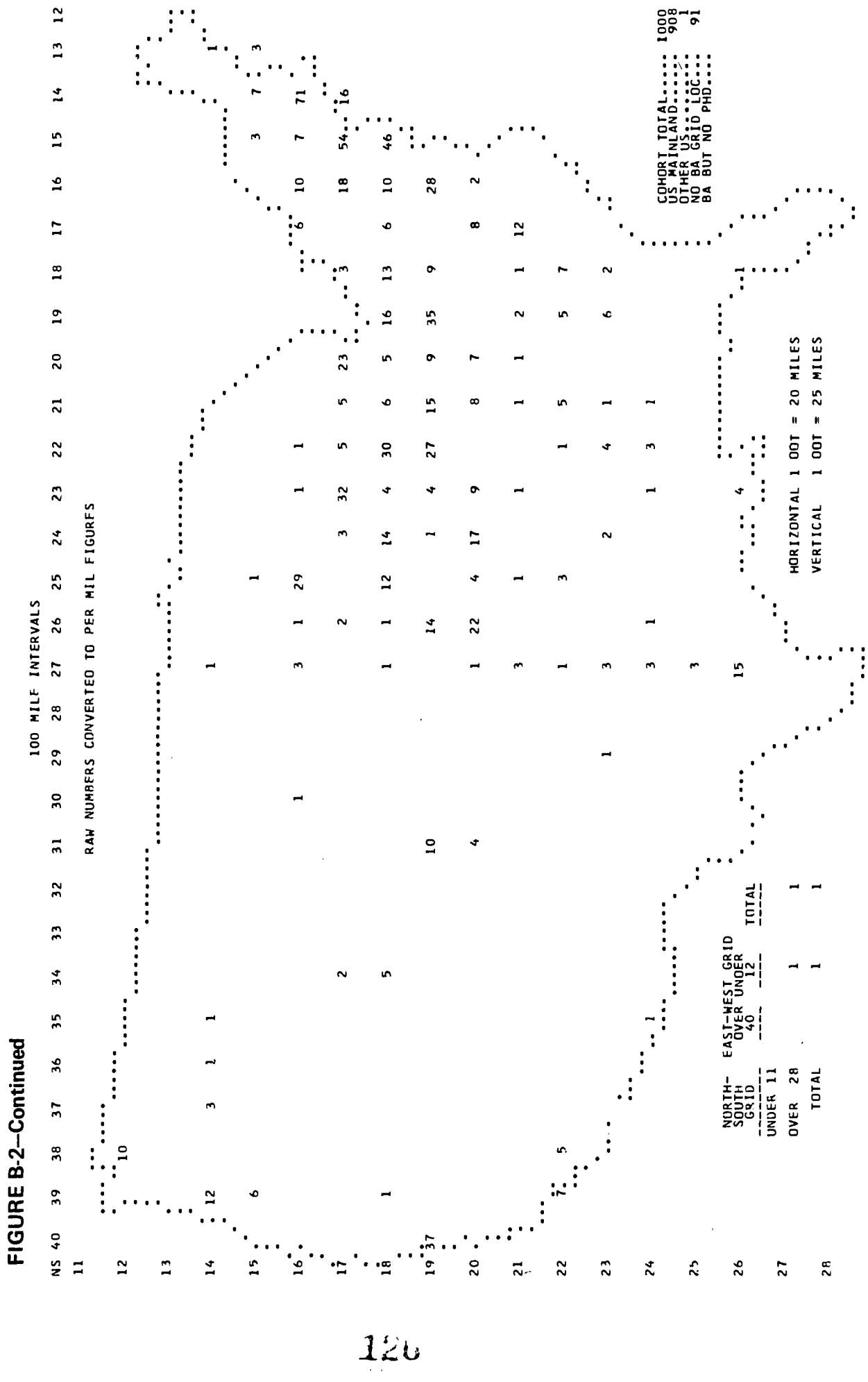


FIGURE B-2—Continued

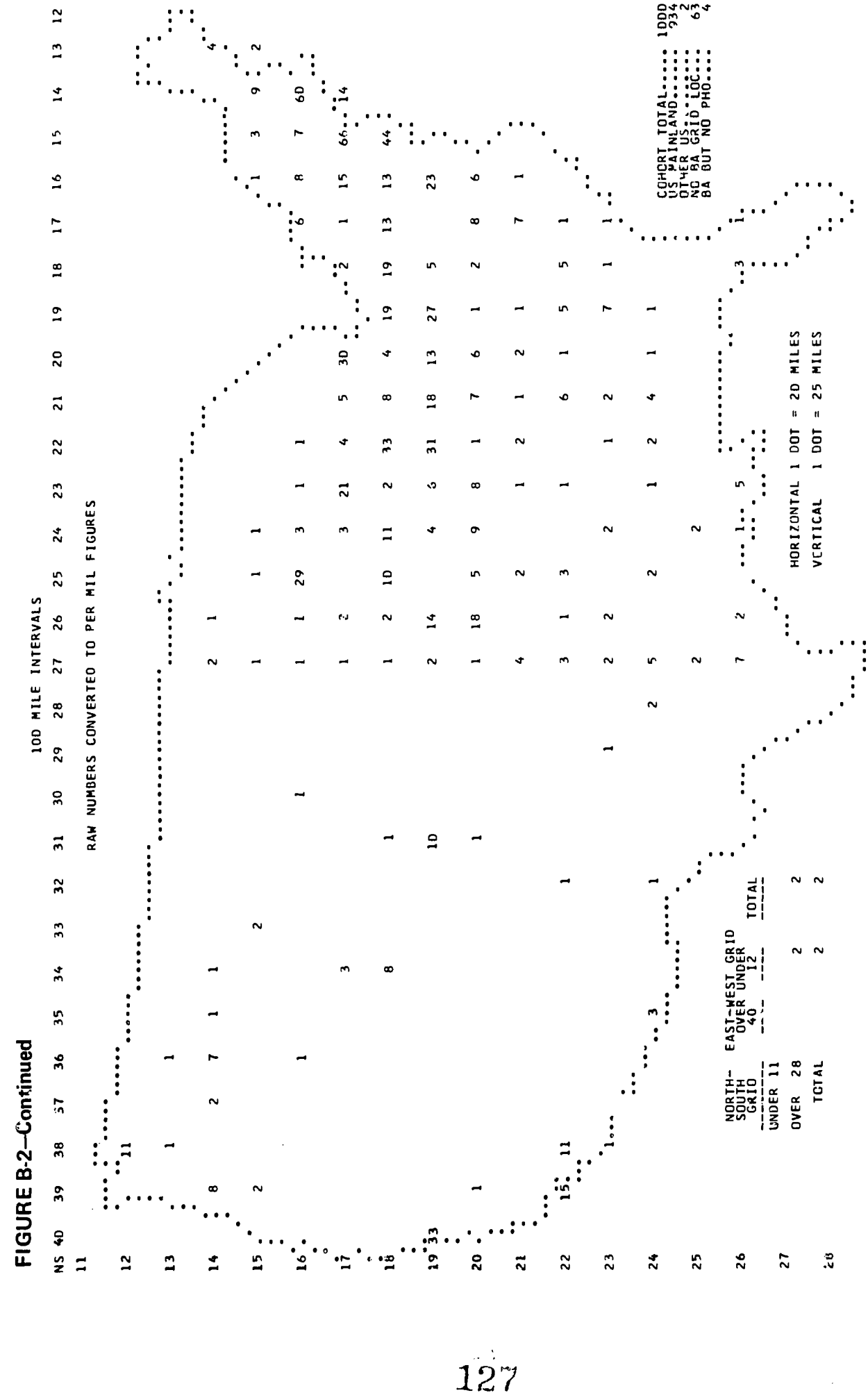


FIGURE B-2--Continued

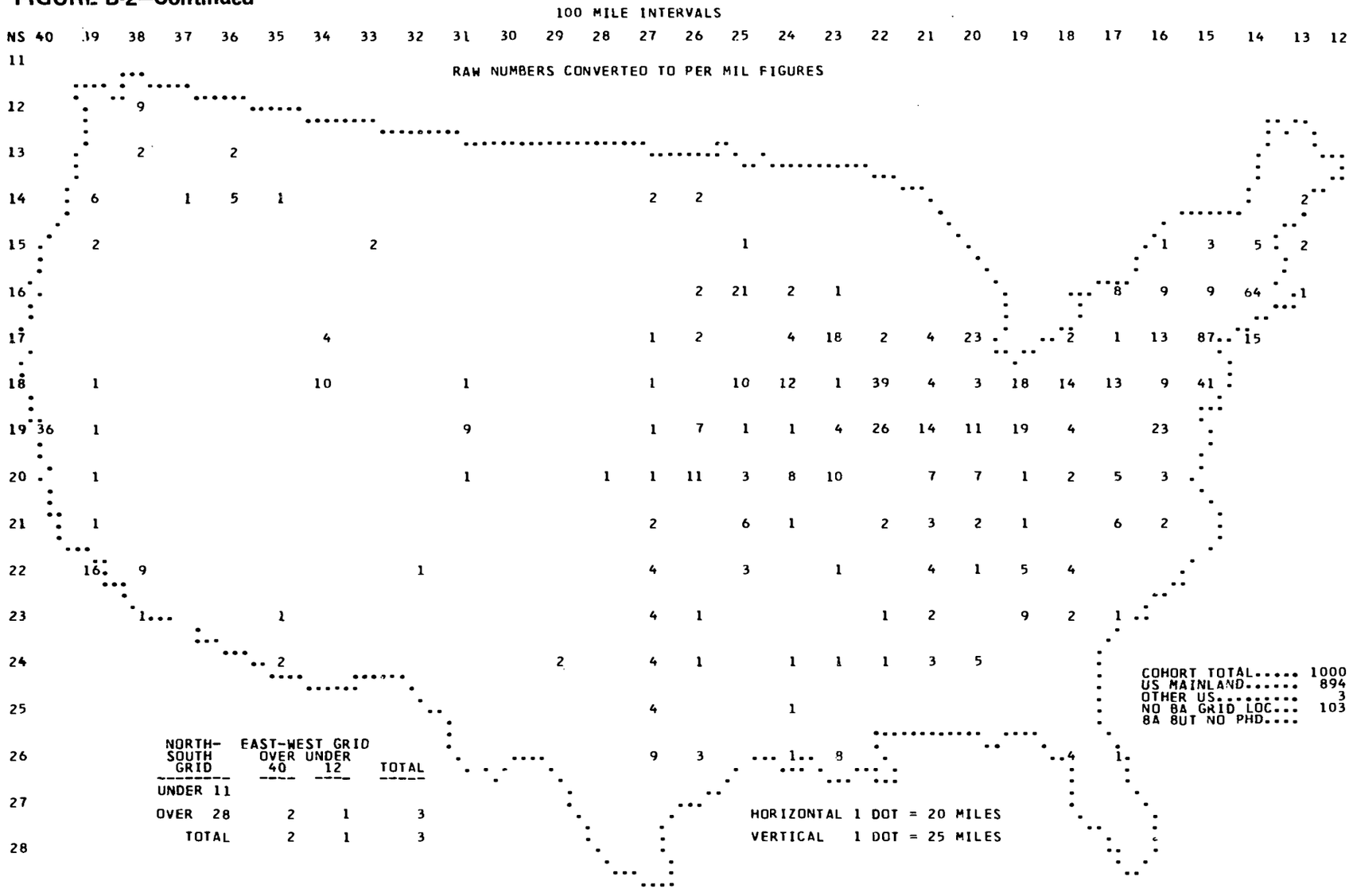


FIGURE B-2—Continued

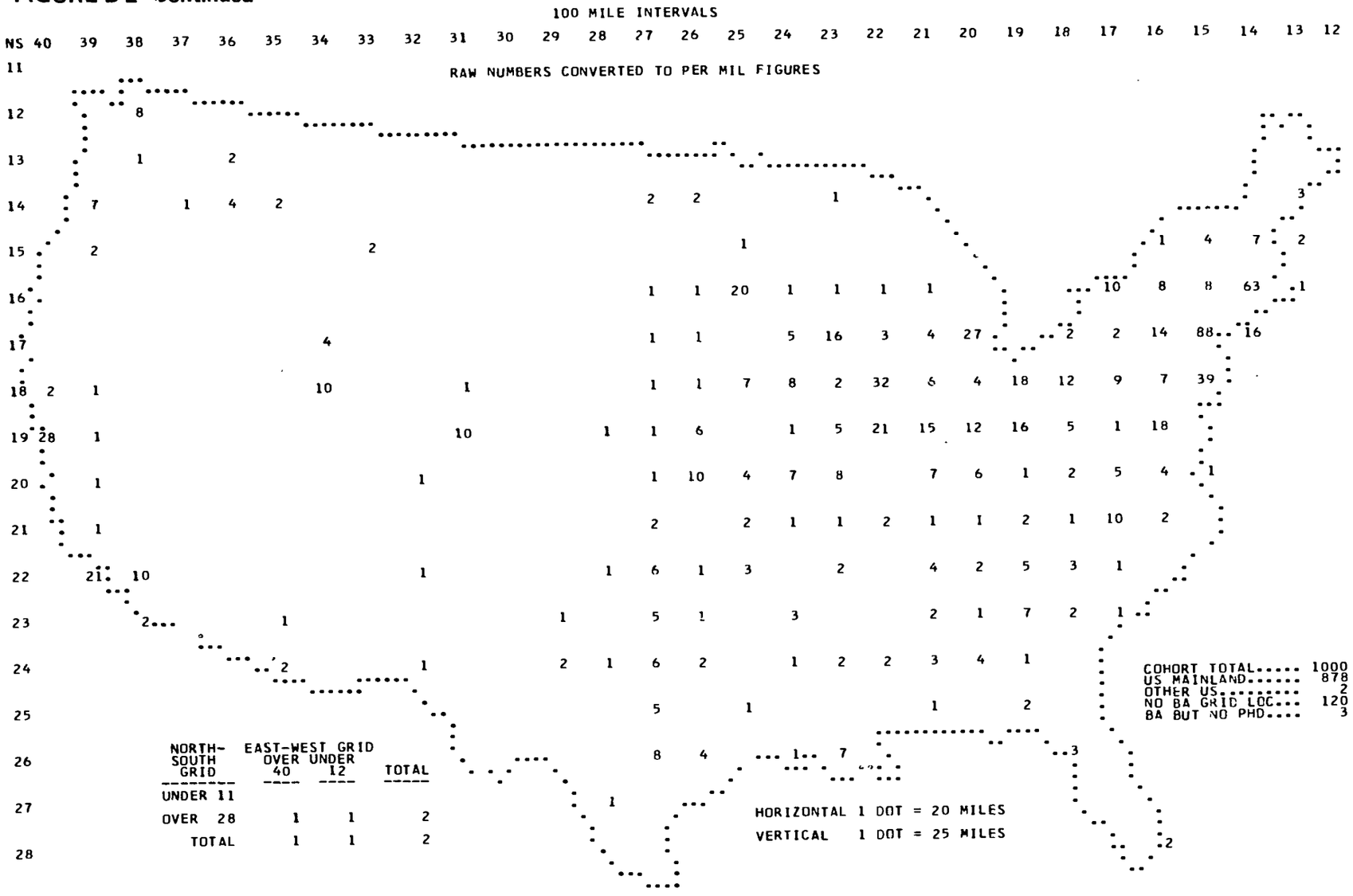


TABLE B-1

Interregional Migration: BA to PhD

TOTAL ALL FIELDS 1920'S

REGION OF PhD		REGION OF BACCALAUREATE N.E.	MA	ENC	WNC	SA	ESC	WSC	MTN	PAC	TOTAL US	TOTAL FOR	GRAND TOTAL
NEW ENGLAND	N	717	245	260	157	89	31	43	31	90	1663	193	1856
	H	43.1	14.7	15.6	9.4	5.4	1.9	2.6	1.9	5.4	89.6	10.4	100.0
	V	50.9	11.6	9.1	10.1	8.5	10.4	12.0	9.7	11.2	15.5	16.7	15.6
MID-ATLANTIC	N	326	1385	408	233	234	64	64	65	109	2888	395	3283
	H	11.3	48.0	14.1	8.1	8.1	2.2	2.2	2.3	3.8	88.0	12.0	100.0
	V	23.1	65.8	14.2	15.0	22.3	21.5	17.9	20.3	13.5	26.8	34.1	27.5
EAST-NORTH-CEN	N	193	223	1745	424	127	77	107	91	110	3097	290	3387
	H	6.2	7.2	56.3	13.7	4.1	2.5	3.5	2.9	3.6	91.4	8.6	100.0
	V	13.7	10.6	60.9	27.4	12.1	25.9	29.9	28.4	13.6	28.8	25.0	28.4
WEST-NORTH-CEN	N	35	54	176	562	32	24	31	35	44	993	67	1060
	H	3.5	5.4	17.7	56.6	3.2	2.4	3.1	3.5	4.4	93.7	6.3	100.0
	V	2.5	2.6	6.1	36.3	3.0	8.1	8.7	10.9	5.5	9.2	5.8	8.9
S. ATLANTIC	N	85	142	150	81	537	46	34	21	26	1122	126	1248
	H	7.6	12.7	13.4	7.2	47.9	4.1	3.0	1.9	2.3	89.9	10.1	100.0
	V	6.0	6.7	5.2	5.2	51.1	15.5	9.5	6.6	3.2	10.4	10.9	10.5
EAST SOUTH CEN	N	1	4	4	10	13	42	4	2	1	81	5	86
	H	1.2	4.9	4.9	12.3	16.0	51.9	4.9	2.5	1.2	94.2	5.8	100.0
	V	.1	.2	.1	.6	1.2	14.1	1.1	.6	.1	.8	.4	.7
WEST SOUTH CEN	N	3	2	3	1	2	2	39	2		54	1	55
	H	5.6	3.7	5.6	1.9	3.7	3.7	72.2	3.7		98.2	1.8	100.0
	V	.2	.1	.1	.1	.2	.7	10.9	.6		.5	.1	.5
MOUNTAIN	N	2		5	6	3	3	2	5	1	27	4	31
	H	7.4		18.5	22.2	11.1	11.1	7.4	18.5	3.7	87.1	12.9	100.0
	V	.1		.2	.4	.3	1.0	.6	1.6	.1	.3	.3	.3
PACIFIC	N	47	49	114	76	14	8	34	68	425	835	77	912
	H	5.6	5.9	13.7	9.1	1.7	1.0	4.1	8.1	50.9	91.6	8.4	100.0
	V	3.3	2.3	4.0	4.9	1.3	2.7	9.5	21.3	52.7	7.8	6.6	7.7
TOTAL U.S.	N	1409	2104	2865	1550	1051	297	358	320	806	10760	1158	11918
	H	13.1	19.6	26.6	14.4	9.8	2.8	3.3	3.0	7.5	90.3	9.7	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GRAND TOTAL	N	1409	2104	2865	1550	1051	297	358	320	806	10760	1158	11918
	H	13.1	19.6	26.6	14.4	9.8	2.8	3.3	3.0	7.5	90.3	9.7	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE B-1—Continued

TOTAL ALL FIELDS 1930'S

REGION OF PhD		REGION OF BACCALAUREATE N.E.	MA	ENC	WNC	SA	ESC	WSC	MTN	PAC	TOTAL US	TOTAL FOR	GRAND TOTAL
NEW ENGLAND	N	1464	471	502	278	190	69	123	81	206	3384	327	3711
	H	43.3	13.9	14.8	8.2	5.6	2.0	3.6	2.4	6.1	91.2	8.8	100.0
	V	54.5	10.3	8.3	7.9	9.1	8.8	11.5	9.2	9.5	14.2	17.4	14.5
MID-ATLANTIC	N	654	3147	877	557	442	134	181	157	290	6439	563	7002
	H	10.2	48.9	13.6	8.7	6.9	2.1	2.8	2.4	4.5	92.0	8.0	100.0
	V	24.3	69.1	14.6	15.8	21.1	17.2	16.9	17.9	13.4	27.1	30.0	27.3
EAST-NORTH-CEN	N	267	423	3663	763	292	213	205	225	269	6320	470	6790
	H	4.2	6.7	58.0	12.1	4.6	3.4	3.2	3.6	4.3	93.1	6.9	100.0
	V	9.9	9.3	60.9	21.6	13.9	27.3	19.2	25.6	12.4	26.6	25.0	26.5
WEST-NORTH-CEN	N	80	94	430	1499	85	72	103	135	109	2607	135	2742
	H	3.1	3.6	16.5	57.5	3.3	2.8	4.0	5.2	4.2	95.1	4.9	100.0
	V	3.0	2.1	7.1	42.5	4.0	9.2	9.6	15.4	5.0	11.0	7.2	10.7
S. ATLANTIC	N	149	297	253	177	976	109	69	41	61	2132	208	2340
	H	7.0	13.9	11.9	8.3	45.8	5.1	3.2	1.9	2.9	91.1	8.9	100.0
	V	5.5	6.5	4.2	5.0	46.5	14.0	6.5	4.7	2.8	9.0	11.1	9.1
EAST SOUTH CEN	N	4	7	26	29	60	154	36	2	2	320	5	325
	H	1.3	2.2	8.1	9.1	18.8	48.1	11.3	.6	.6	98.5	1.5	100.0
	V	.1	.2	.4	.8	2.9	19.7	3.4	.2	.1	1.3	.3	1.3
WEST SOUTH CEN	N	7	11	28	26	9	12	284	9	11	397	4	401
	H	1.8	2.8	7.1	6.5	2.3	3.0	71.5	2.3	2.8	99.0	1.0	100.0
	V	.3	.2	.5	.7	.4	1.5	26.6	1.0	.5	1.7	.2	1.6
MOUNTAIN	N	4	7	20	26	5	3	11	50	9	135	9	144
	H	3.0	5.2	14.8	19.3	3.7	2.2	8.1	37.0	6.7	93.8	6.3	100.1
	V	.1	.2	.3	.7	.2	.4	1.0	5.7	.4	.6	.5	.6
PACIFIC	N	58	96	217	173	40	15	57	179	1208	2043	156	2199
	H	2.8	4.7	10.6	8.5	2.0	.7	2.8	8.8	59.1	92.9	7.1	100.0
	V	2.2	2.1	3.6	4.9	1.9	1.9	5.3	20.4	55.8	8.6	8.3	8.6
TOTAL U.S.	N	2687	4553	6016	3528	2099	781	1069	879	2165	23777	1877	25654
	H	11.3	19.1	25.3	14.8	8.8	3.3	4.5	3.7	9.1	92.7	7.3	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GRAND TOTAL	N	2687	4553	6016	3528	2099	781	1069	879	2165	23777	1877	25654
	H	11.3	19.1	25.3	14.8	8.8	3.3	4.5	3.7	9.1	92.7	7.3	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE B-1—Continued

TOTAL ALL FIELDS 1940'S

REGION OF PhD		REGION OF BACCALAUREATE N.E.	MA	ENC	WNC	SA	ESC	WSC	MTN	PAC	TOTAL US	TOTAL FOR	GRAND TOTAL
NEW ENGLAND	N	1405	654	465	214	218	76	113	93	249	3487	471	3958
	H	40.3	18.8	13.3	6.1	6.3	2.2	3.2	2.7	7.1	88.1	11.9	100.0
	V	49.0	10.8	6.9	5.7	8.4	8.0	7.8	8.1	8.8	12.3	21.0	12.9
MID-ATLANTIC	N	711	3872	1002	514	519	197	195	184	314	7508	575	8083
	H	9.5	51.6	13.3	6.8	6.9	2.6	2.6	2.5	4.2	92.9	7.1	100.0
	V	24.8	64.0	15.0	13.7	20.1	20.7	13.5	16.1	11.1	26.5	25.7	26.4
EAST-NORTH-CEN	N	398	786	4129	893	423	287	297	312	385	7910	569	8479
	H	5.0	9.9	52.2	11.3	5.3	3.6	3.8	3.9	4.9	93.3	6.7	100.0
	V	13.9	13.0	61.7	23.8	16.3	30.1	20.6	27.2	13.6	27.9	25.4	27.7
WEST-NORTH-CEN	N	84	180	450	1574	111	58	111	173	144	2885	223	3108
	H	2.9	6.2	15.6	54.6	3.8	2.0	3.8	6.0	5.0	92.8	7.2	100.0
	V	2.9	3.0	6.7	41.9	4.3	6.1	7.7	15.1	5.1	10.2	10.0	10.2
S. ATLANTIC	N	132	330	298	156	1153	120	77	49	83	2398	108	2506
	H	5.5	13.8	12.4	6.5	48.1	5.0	3.2	2.0	3.5	95.7	4.3	100.0
	V	4.6	5.5	4.5	4.2	44.6	12.6	5.3	4.3	2.9	8.5	4.8	8.2
EAST SOUTH CEN	N	1	9	18	25	60	140	37	2	5	297	1	298
	H	.3	3.0	6.1	8.4	20.2	47.1	12.5	.7	1.7	99.7	.3	100.0
	V		.1	.3	.7	2.3	14.7	2.6	.2	.2	1.0		1.0
WEST SOUTH CEN	N	16	22	42	49	33	40	483	12	26	723	12	735
	H	2.2	3.0	5.8	6.8	4.6	5.5	66.8	1.7	3.6	98.4	1.6	100.0
	V	.6	.4	.6	1.3	1.3	4.2	33.5	1.0	.9	2.6	.5	2.4
MOUNTAIN	N	5	16	44	81	7	4	32	93	18	300	15	315
	H	1.7	5.3	14.7	27.0	2.3	1.3	10.7	31.0	6.0	95.2	4.8	100.0
	V	.2	.3	.7	2.2	.3	.4	2.2	8.1	.6	1.1	.7	1.0
PACIFIC	N	113	182	247	248	64	31	98	228	1615	2826	265	3091
	H	4.0	6.4	8.7	8.8	2.3	1.1	3.5	8.1	57.1	91.4	8.6	100.0
	V	3.9	3.0	3.7	6.6	2.5	3.3	6.8	19.9	56.9	10.0	11.8	10.1
TOTAL U.S.	N	2865	6051	6695	3754	2588	953	1443	1146	2839	28334	2239	30573
	H	10.1	21.4	23.6	13.2	9.1	3.4	5.1	4.0	10.0	92.7	7.3	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GRAND TOTAL	N	2865	6051	6695	3754	2588	953	1443	1146	2839	28334	2239	30573
	H	10.1	21.4	23.6	13.2	9.1	3.4	5.1	4.0	10.0	92.7	7.3	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE B-1—Continued

TOTAL ALL FIELDS 1950'S

REGION OF PhD		REGION OF BACCALAUREATE N.E.	MA	ENC	WNC	SA	ESC	WSC	MTN	PAC	TOTAL US	TOTAL FOR	GRAND TOTAL
NEW ENGLAND	N	3359	1730	949	379	444	141	212	152	516	7882	1058	8940
	H	42.6	21.9	12.0	4.8	5.6	1.8	2.7	1.9	6.5	88.2	11.8	100.0
	V	44.2	9.9	5.8	4.5	7.0	4.9	4.6	4.6	6.7	10.5	13.1	10.8
MID-ATLANTIC	N	1717	10302	2037	830	1248	407	393	446	775	18155	1840	19995
	H	9.5	56.7	11.2	4.6	6.9	2.2	2.2	2.5	4.3	90.8	9.2	100.0
	V	22.6	59.0	12.4	9.9	19.7	14.1	8.4	13.6	10.0	24.3	22.8	24.1
EAST-NORTH-CEN	N	1169	2505	9939	1875	1167	740	776	697	841	19709	2385	22094
	H	5.9	12.7	50.4	9.5	5.9	3.8	3.9	3.5	4.3	89.2	10.8	100.0
	V	15.4	14.3	60.5	22.3	18.4	25.7	16.7	21.3	10.9	26.4	29.5	26.7
WEST-NORTH-CEN	N	291	558	1164	3558	258	187	369	350	312	7047	828	7875
	H	4.1	7.9	16.5	50.5	3.7	2.7	5.2	5.0	4.4	89.5	10.5	100.0
	V	3.8	3.2	7.1	42.3	4.1	6.5	7.9	10.7	4.0	9.4	10.3	9.5
S. ATLANTIC	N	422	1213	697	341	2562	392	259	121	216	6223	540	6763
	H	6.8	19.5	11.2	5.5	41.2	6.3	4.2	1.9	3.5	92.0	8.0	100.0
	V	5.6	6.9	4.2	4.1	40.4	13.6	5.6	3.7	2.8	8.3	6.7	8.2
EAST SOUTH CEN	N	45	91	147	80	199	701	155	17	15	1450	44	1494
	H	3.1	6.3	10.1	5.5	13.7	48.3	10.7	1.2	1.0	97.1	2.9	100.0
	V	.6	.5	.9	1.0	3.1	24.3	3.3	.5	.2	1.9	.5	1.8
WEST SOUTH CEN	N	84	166	230	230	189	188	2077	91	95	3350	218	3568
	H	2.5	5.0	6.9	6.9	5.6	5.6	62.0	2.7	2.8	93.9	6.1	100.0
	V	1.1	1.0	1.4	2.7	3.0	6.5	44.6	2.8	1.2	4.5	2.7	4.3
MOUNTAIN	N	51	137	261	414	48	28	139	685	164	1927	118	2045
	H	2.6	7.1	13.5	21.5	2.5	1.5	7.2	35.5	8.5	94.2	5.8	100.0
	V	.7	.8	1.6	4.9	.8	1.0	3.0	20.9	2.1	2.6	1.5	2.5
PACIFIC	N	454	760	1015	712	222	98	279	713	4793	9046	1045	10091
	H	5.0	8.4	11.2	7.9	2.5	1.1	3.1	7.9	53.0	89.6	10.4	100.0
	V	6.0	4.4	6.2	8.5	3.5	3.4	6.0	21.8	62.0	12.1	12.9	12.2
TOTAL U.S.	N	7592	17462	16439	8419	6337	2882	4659	3272	7727	74789	8076	82865
	H	10.2	23.3	22.0	11.3	8.5	3.9	6.2	4.4	10.3	90.3	9.7	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GRAND TOTAL	N	7592	17462	16439	8419	6337	2882	4659	3272	7727	74789	8076	82865
	H	10.2	23.3	22.0	11.3	8.5	3.9	6.2	4.4	10.3	90.3	9.7	100.0
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE B-1—Continued

TOTAL ALL FIELDS 1960'S

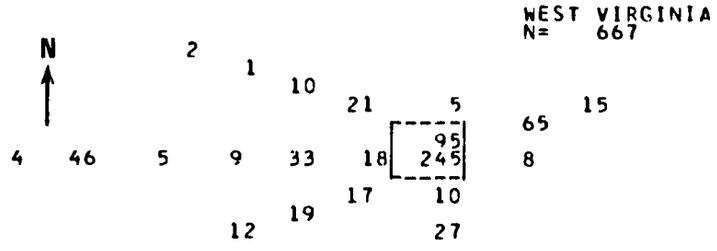
REGION OF PhD		REGION OF BACCALAUREATE N.E.	MA	ENC	WNC	SA	ESC	WSC	MTN	PAC	TOTAL US	TOTAL FOR	GRAND TOTAL
NEW ENGLAND	N	4033	2285	1229	425	513	162	252	197	585	9681	1582	11263
	H	41.7	23.6	12.7	4.4	5.3	1.7	2.6	2.0	6.0	86.0	14.0	100.0
	V	41.0	10.9	6.2	4.1	6.2	4.1	3.5	4.2	5.5	10.1	10.9	106.8
MID-ATLANTIC	N	2105	11345	1932	692	1199	289	350	353	1151	19416	3031	22447
	H	10.8	58.4	10.0	3.6	6.2	1.5	1.8	1.8	5.9	86.5	13.5	100.0
	V	21.4	54.3	9.7	6.6	14.4	7.3	4.9	7.6	10.8	20.2	20.8	212.8
EAST-NORTH-CEN	N	1463	3030	11653	2169	1227	754	903	771	1173	23143	3934	27077
	H	6.3	13.1	50.4	9.4	5.3	3.3	3.9	3.3	5.1	85.5	14.5	100.0
	V	14.9	14.5	58.4	20.7	14.7	19.1	12.5	16.5	11.0	24.1	27.0	256.7
WEST-NORTH-CEN	N	299	628	1358	4506	244	181	468	361	391	8436	1232	9668
	H	3.5	7.4	16.1	53.4	2.9	2.1	5.5	4.3	4.6	87.3	12.7	100.0
	V	3.0	3.0	6.8	43.1	2.9	4.6	6.5	7.7	3.7	8.8	8.5	91.6
S. ATLANTIC	N	663	1640	1033	490	3910	716	434	181	368	9435	1208	10643
	H	7.0	17.4	10.9	5.2	41.4	7.6	4.6	1.9	3.9	88.6	11.4	100.0
	V	6.7	7.8	5.2	4.7	46.9	18.2	6.0	3.9	3.4	9.8	8.3	100.9
EAST SOUTH CEN	N	66	133	186	112	405	1283	256	35	50	2526	149	2675
	H	2.6	5.3	7.4	4.4	16.0	50.8	10.1	1.4	2.0	94.4	5.6	100.0
	V	.7	.6	.9	1.1	4.9	32.6	3.6	.8	.5	2.6	1.0	25.4
WEST SOUTH CEN	N	131	281	399	499	316	342	3815	190	183	6156	692	6848
	H	2.1	4.6	6.5	8.1	5.1	5.6	62.0	3.1	3.0	89.9	10.1	100.0
	V	1.3	1.3	2.0	4.8	3.8	8.7	52.9	4.1	1.7	6.4	4.8	64.9
MOUNTAIN	N	141	306	591	675	137	68	313	1573	450	4254	423	4677
	H	3.3	7.2	13.9	15.9	3.2	1.6	7.4	37.0	10.6	91.0	9.0	100.0
	V	1.4	1.5	3.0	6.5	1.6	1.7	4.3	33.7	4.2	4.4	2.9	44.3
PACIFIC	N	937	1255	1578	886	379	144	415	1002	6353	12949	2303	15252
	H	7.2	9.7	12.2	6.8	2.9	1.1	3.2	7.7	49.1	84.9	15.1	100.0
	V	9.5	6.0	7.9	8.5	4.5	3.7	5.8	21.5	59.4	13.5	15.8	144.6
TOTAL U.S.	N	9838	20903	19959	10454	8330	3939	7206	4663	10704	95996	14554	10550
	H	10.2	21.8	20.8	10.9	8.7	4.1	7.5	4.9	11.2	909.9	138.0	47.9
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GRAND TOTAL	N	9838	20903	19959	10454	8330	3939	7206	4663	10704	95996	14554	10550
	H	10.2	21.8	20.8	10.9	8.7	4.1	7.5	4.9	11.2	909.9	138.0	47.9
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

APPENDIX C

Migration from High School to Post-PhD Employment, with Diagrams Showing Directions, Distances, Numbers, and Proportions

The diagrams shown in Appendix C give more detail than do the abbreviated diagrams in the text with respect to any particular stage of migration. That is, they show more gradations of distances moved in each direction. Accordingly, in order not to be too cumbersome, they do not depict as many stages of movement. There is one set of diagrams showing numbers and another showing proportions (numbers per thousand, termed "per mil"). In each set, one page shows the states of origin in each of the nine census regions. It would also be possible to show in a similar set of diagrams, the origins for a given set of states of destination. In the diagrams that follow, the migration from high school to post-PhD employment is depicted, omitting the intermediate college and graduate school stages.

To illustrate the process, the example for West Virginia diagram shows movement to place of first postdoctoral employment of all those people (667 in number), wherever they may have attained their BA's and PhD's, who originally graduated from high schools in West Virginia, and who earned doctorates from 1957 to 1967. The boxed in figures show the number who remain or return to West Virginia (95 cases), and those who move out of West Virginia but not farther than 300 miles from the location of their high school (245). The other figures show the number moving in each of the eight directions from high school to state of employment, by 500-mile intervals. The intervals chosen here (first 300 miles, with 500-mile intervals thereafter) are somewhat arbitrary, but have some rationale. The first 300 miles is taken to represent an easy 1-day automobile trip from home. The 500-mile intervals thereafter represent simply a round number. Other intervals could, of course, be chosen, and the results would not have been appreciably different. Eight people moved generally eastward more than 300 but less than 500 miles (about the maximum possible from any point in West Virginia), 65 moved northeastward a similar distance, and 15 moved northeastward over 500 but less than 1,000 miles. The movements in the other directions may be similarly interpreted. All these movements, it should be noted, are within the confines of the United States. People who moved to foreign countries were excluded from these tabulations, as the distortion due to the earth's curvature would make quantitative measurements meaningless. Destinations are unknown for some of these people. For this reason, the figures in the diagram do not always add up to the total at the top of the diagram.



This diagram shows the destinations of persons originating in West Virginia. In this case, the flow is outward from the center. A similar diagram can be drawn, showing the origins of persons moving into West Virginia (or any other state). In that case, the flow would move toward the center from origins of varying distance in each direction. On the next several pages, the movement from high school origins in each state to post-PhD locations are depicted. The diagrams give the clearest picture of the degree of movement over the longest career span and, thus, the best over-all picture of internal U.S. migration.

FIGURE C-1

Migration from state of high school to post-PhD employment.

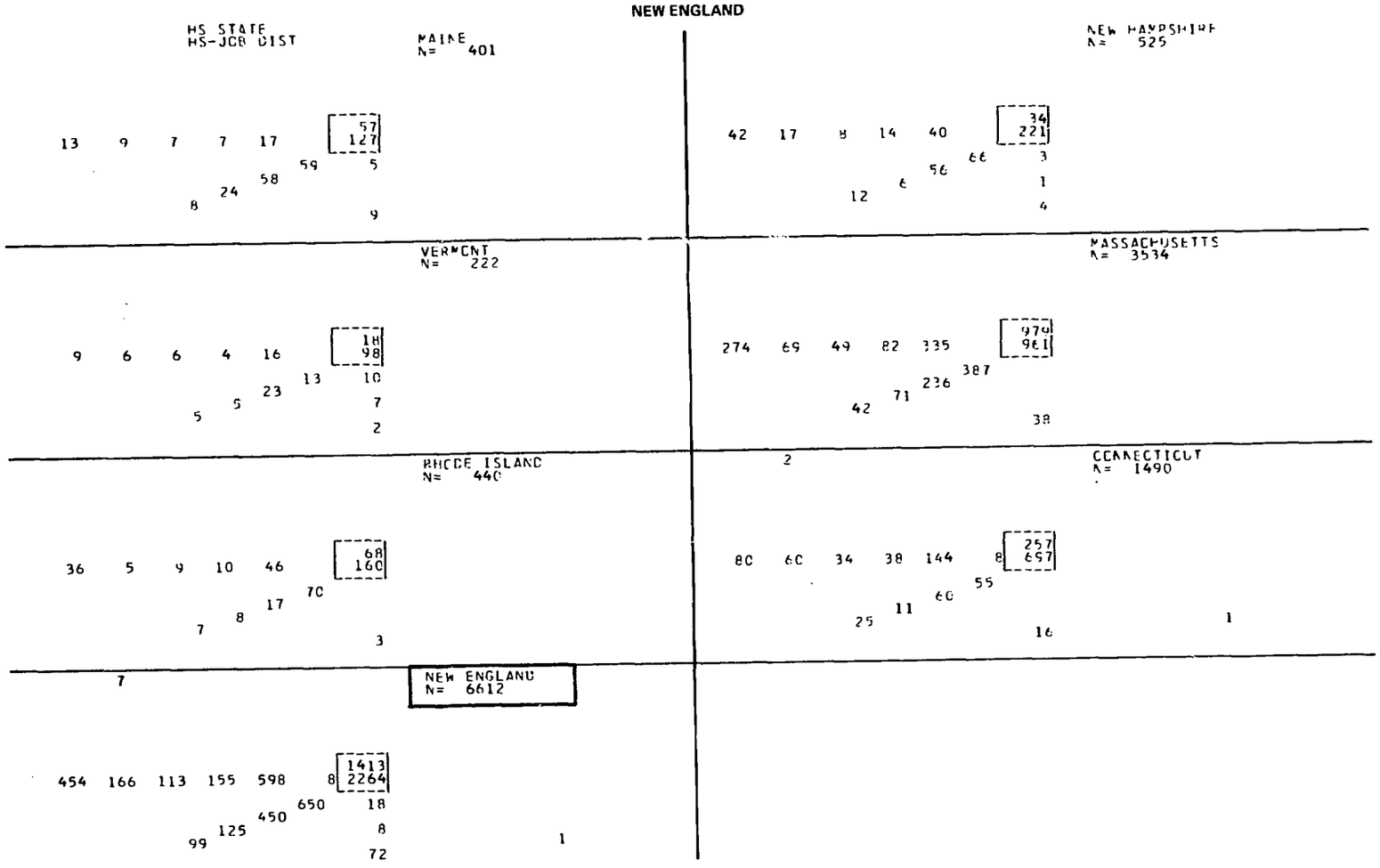


FIGURE C-1—Continued

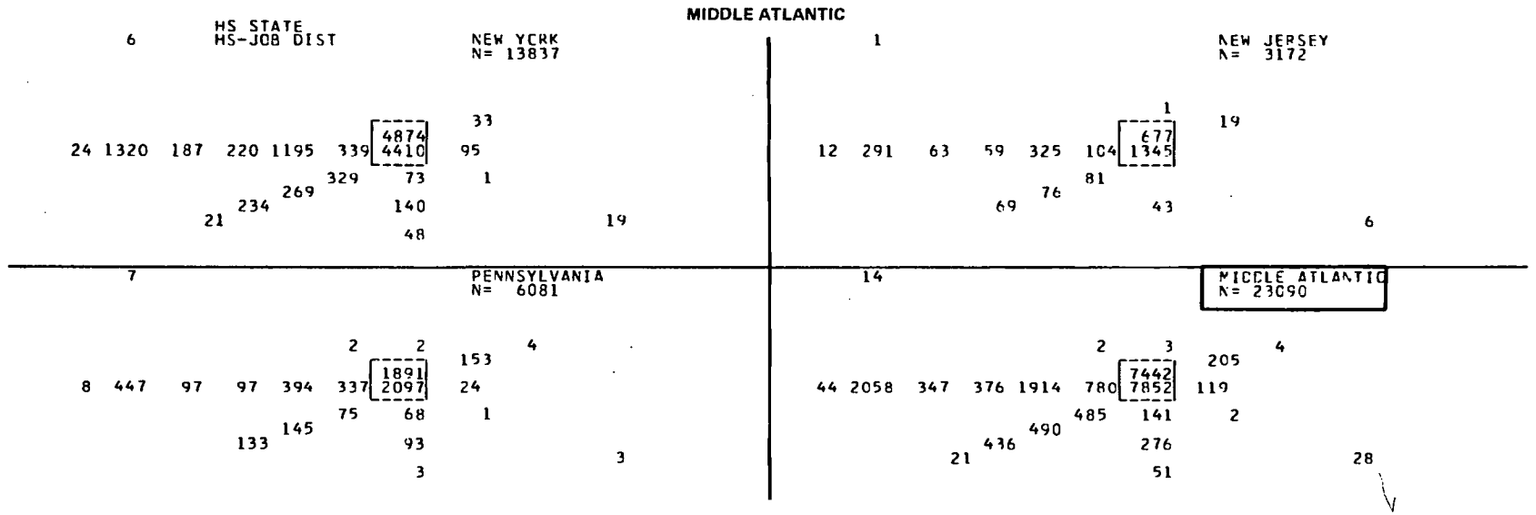


FIGURE C-1—Continued

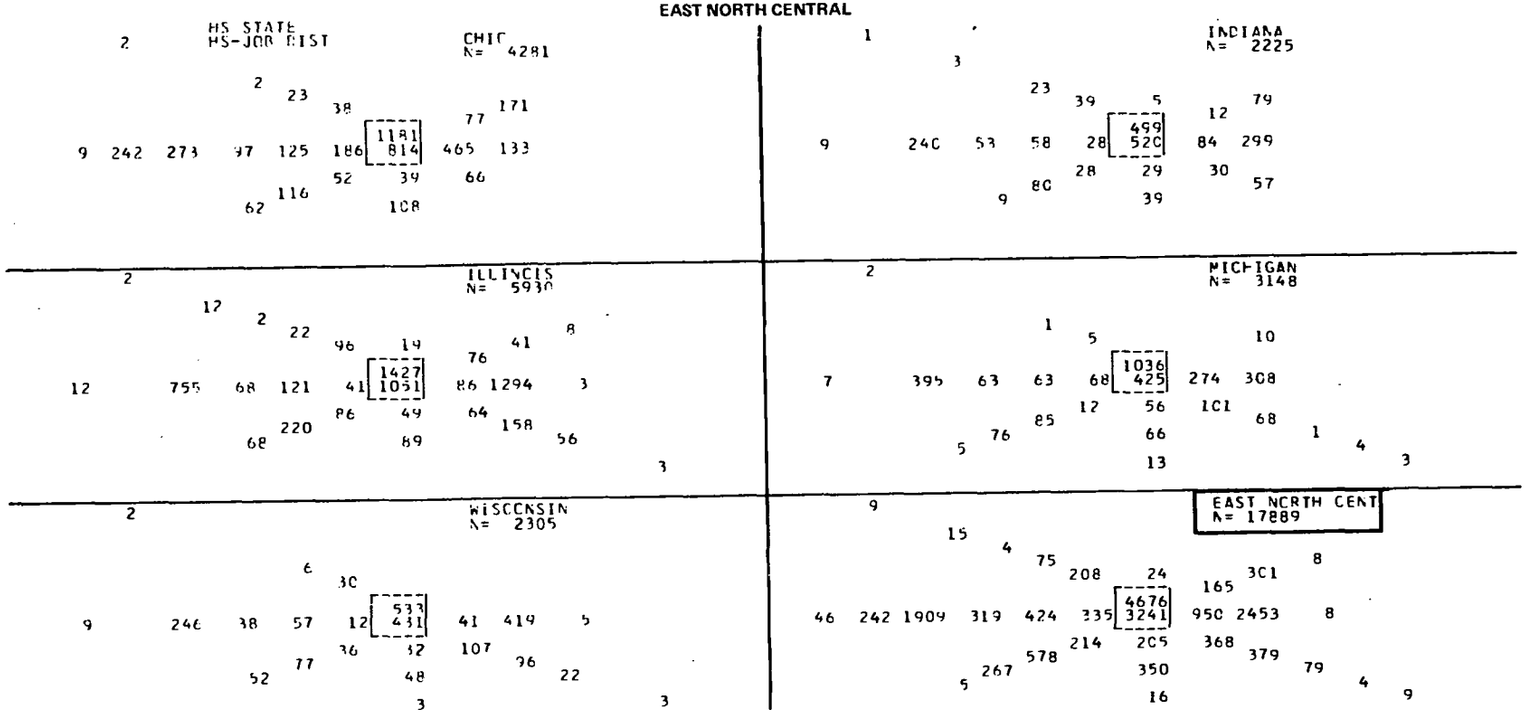


FIGURE C-1—Continued

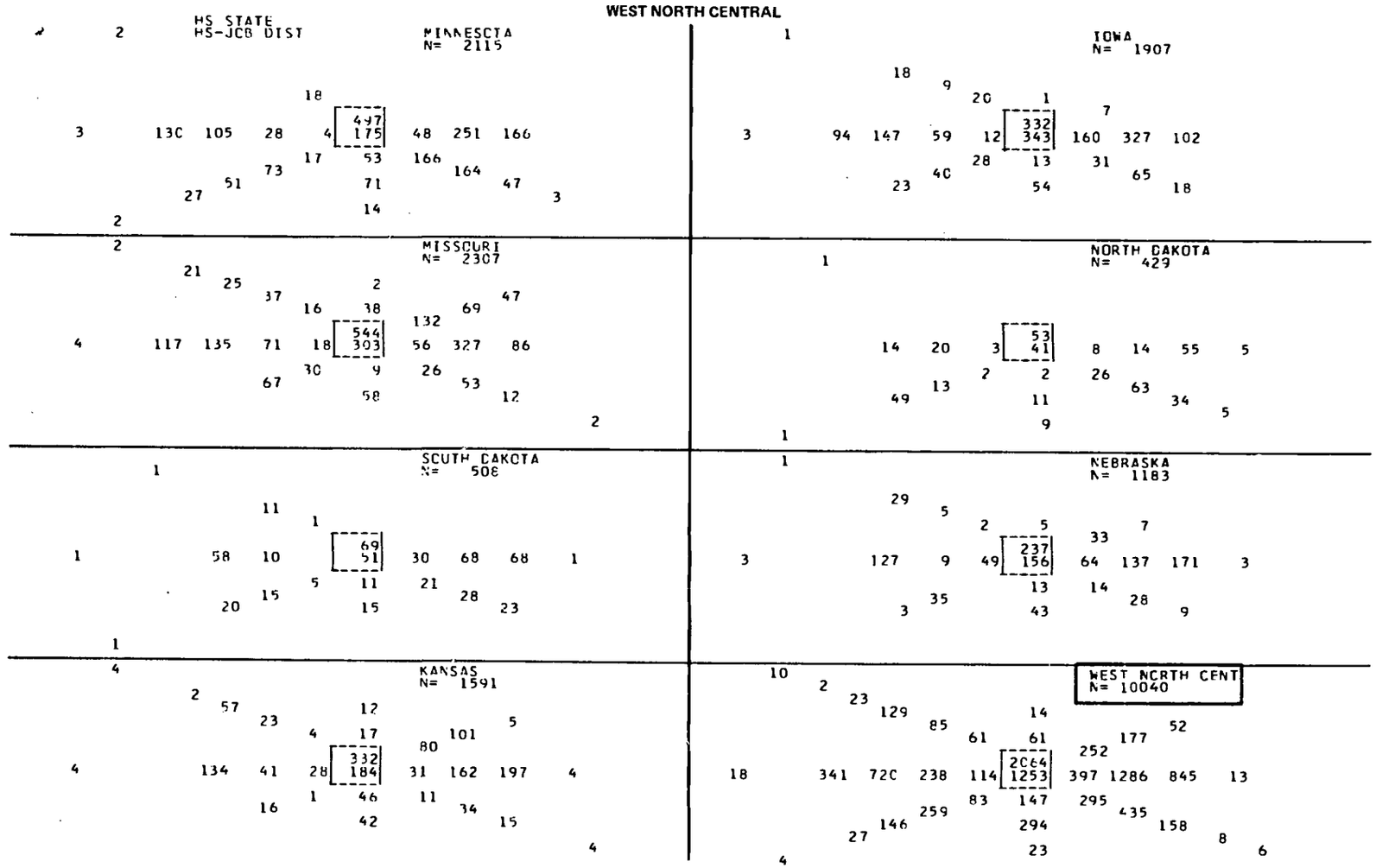


FIGURE C-1—Continued

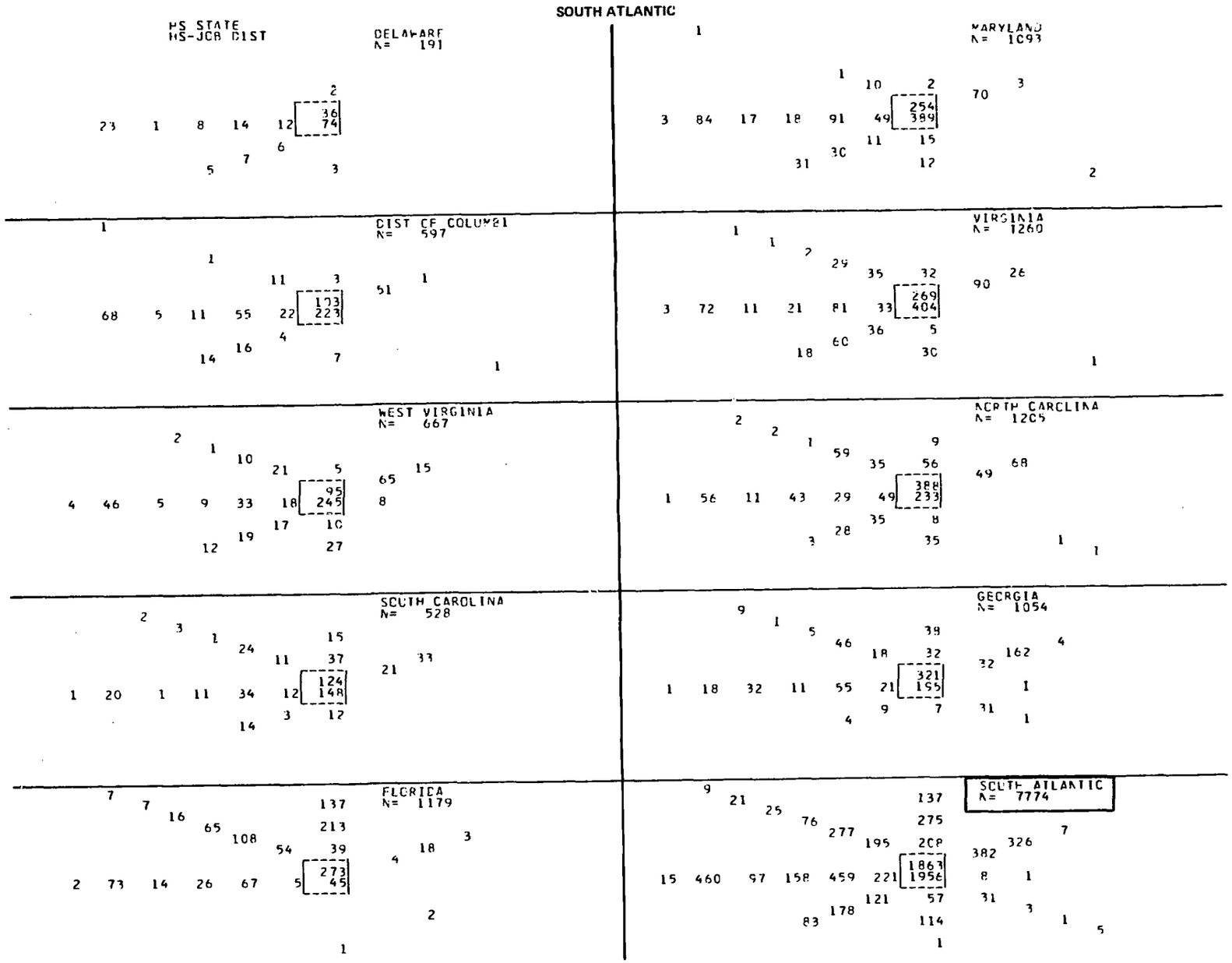


FIGURE C-1—Continued

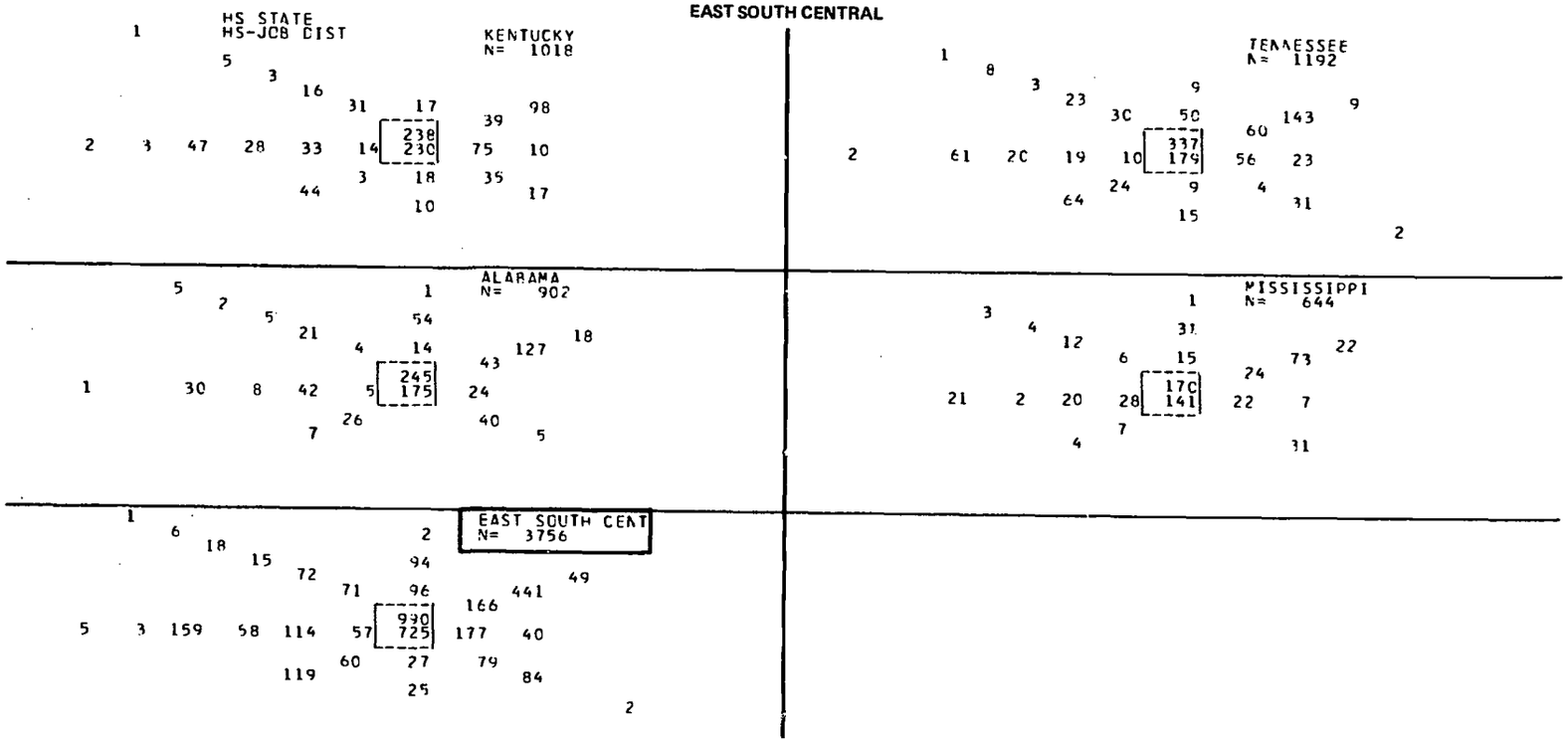


FIGURE C-1—Continued

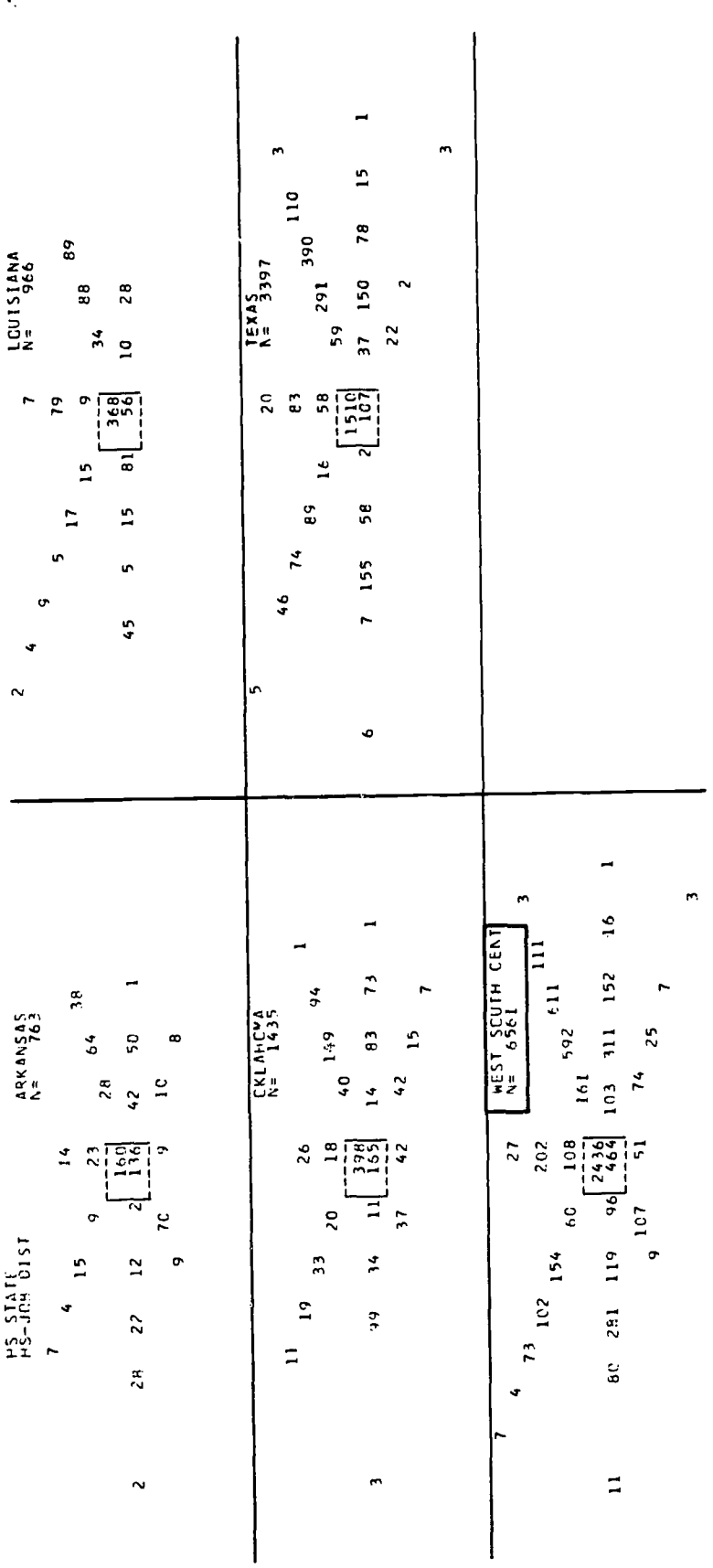


FIGURE C-1—Continued

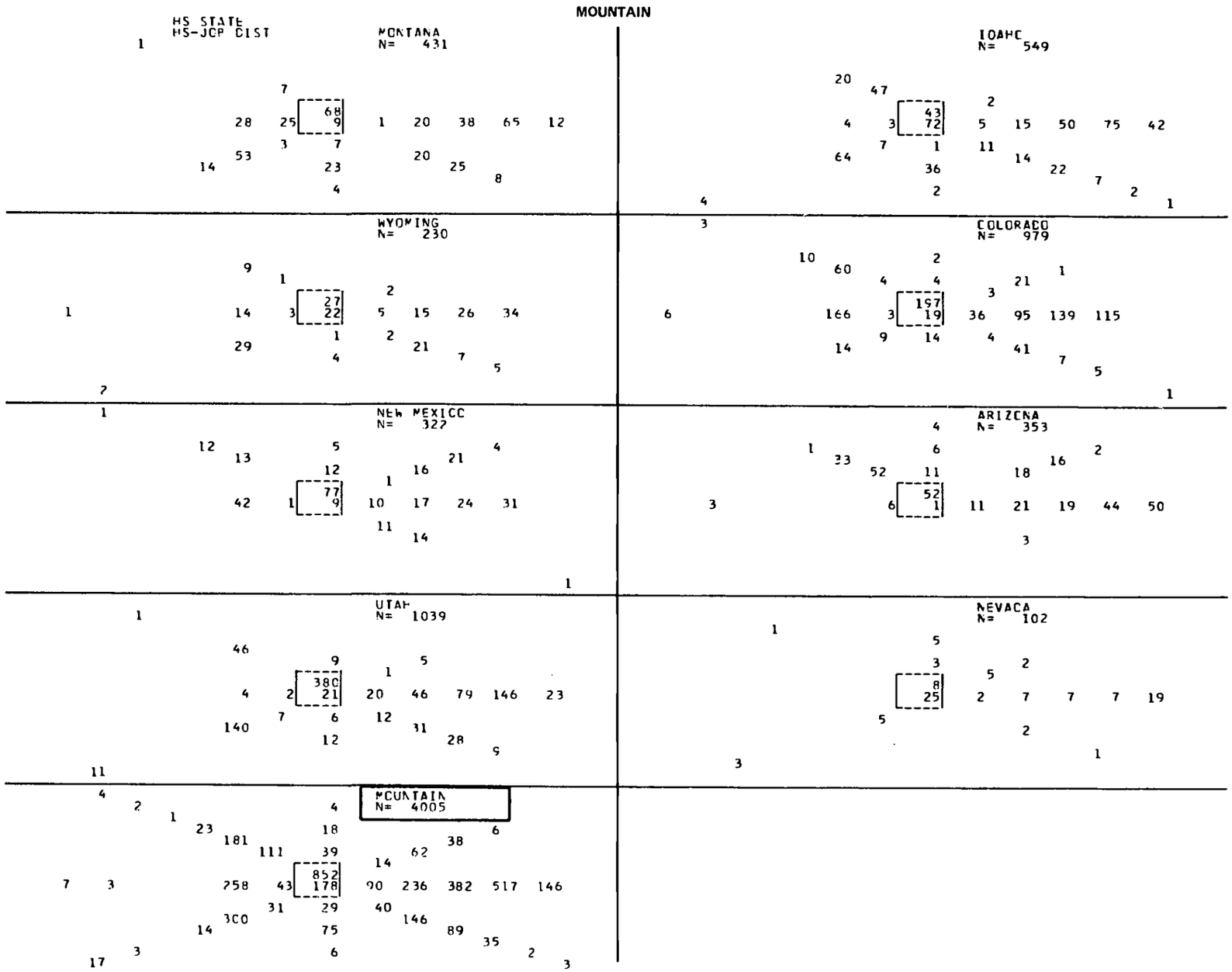
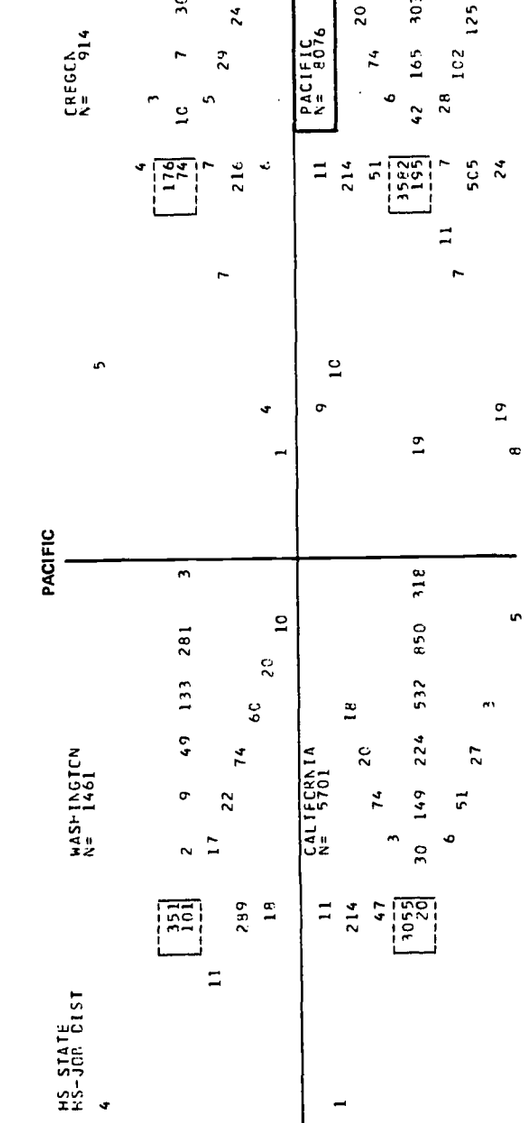


FIGURE C-1—Continued



The foregoing diagrams show the raw numbers of people making each of the high school-to-employment moves. For many purposes, it is more meaningful to show the same data on a percentage basis; as such, the population differences between the states are ignored. It is useful, when dealing with numbers of this magnitude, to carry the percentage computation to one decimal place. In the present computer operation, the decimal point is omitted, thus giving the same information on a "per thousand" basis. This has been termed "per mil" and the high school-to-employment data are shown in the following diagrams on this basis.

FIGURE C-2

Migration from state of high school to post-PhD employment (per mil).

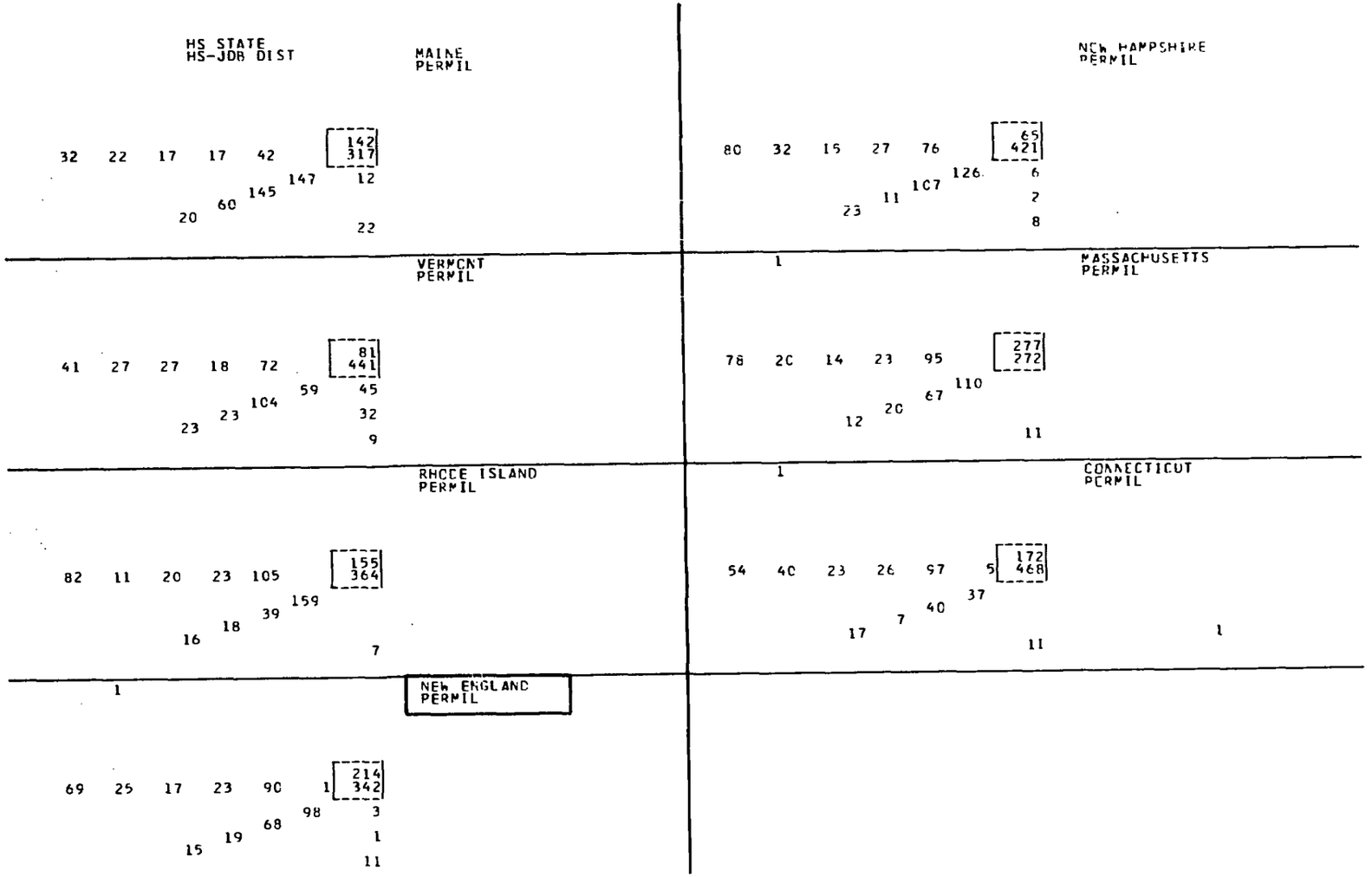


FIGURE C-2—Continued

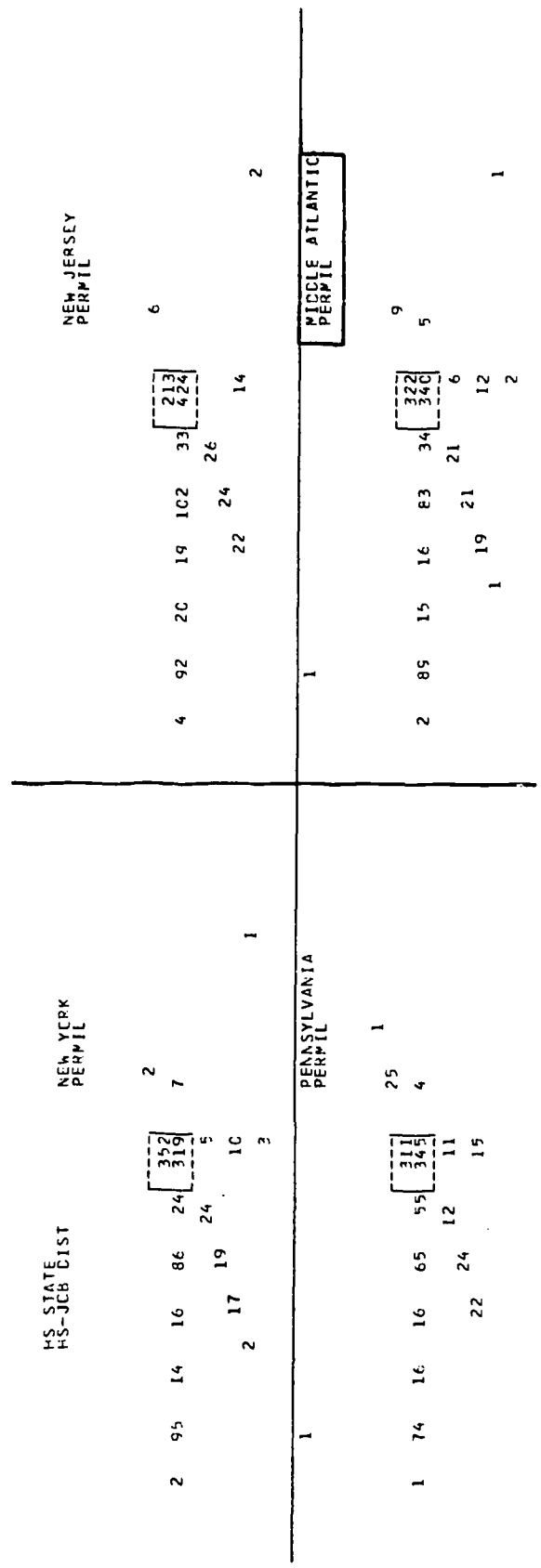


FIGURE C-2—Continued

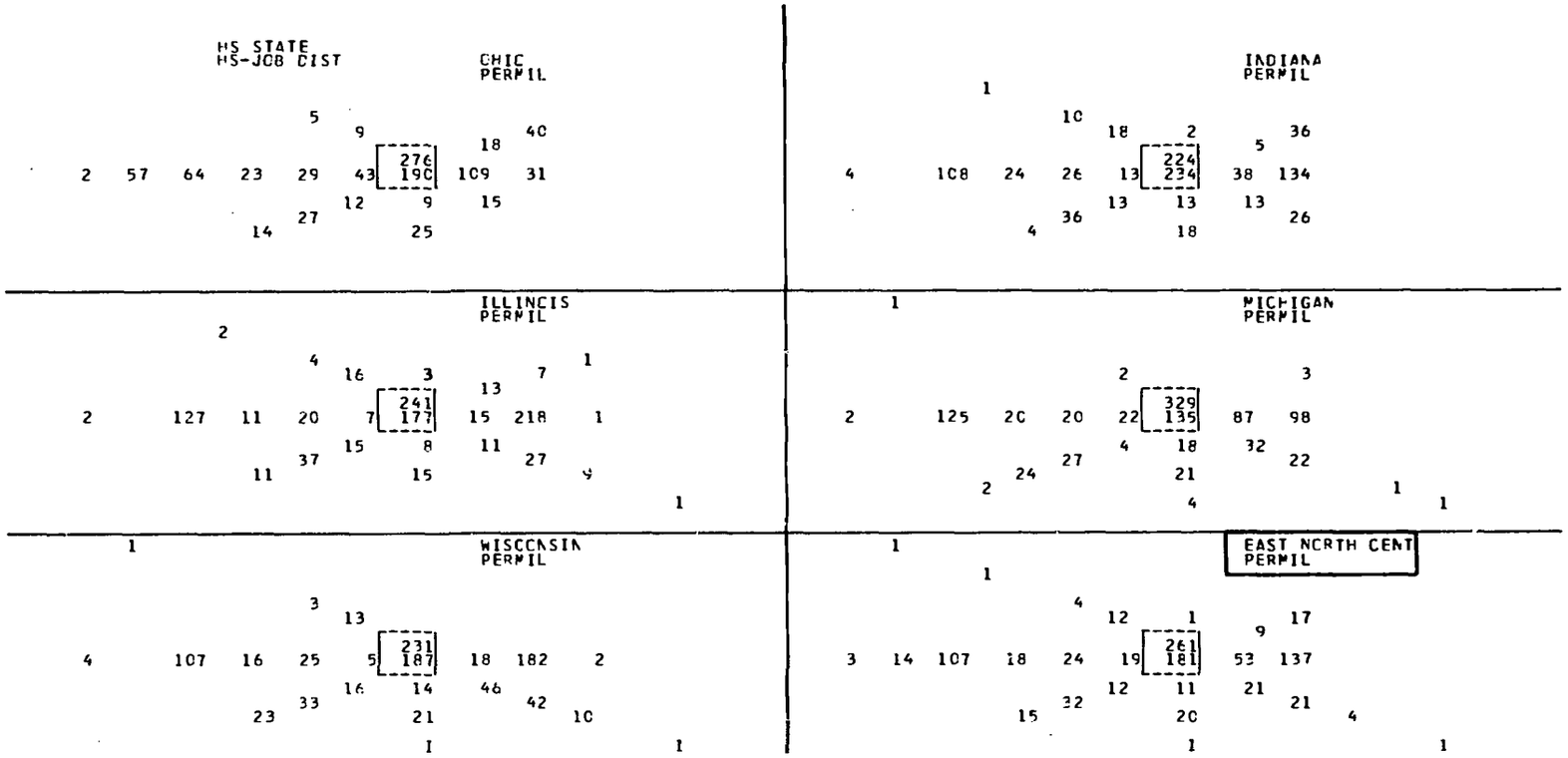


FIGURE C-2—Continued

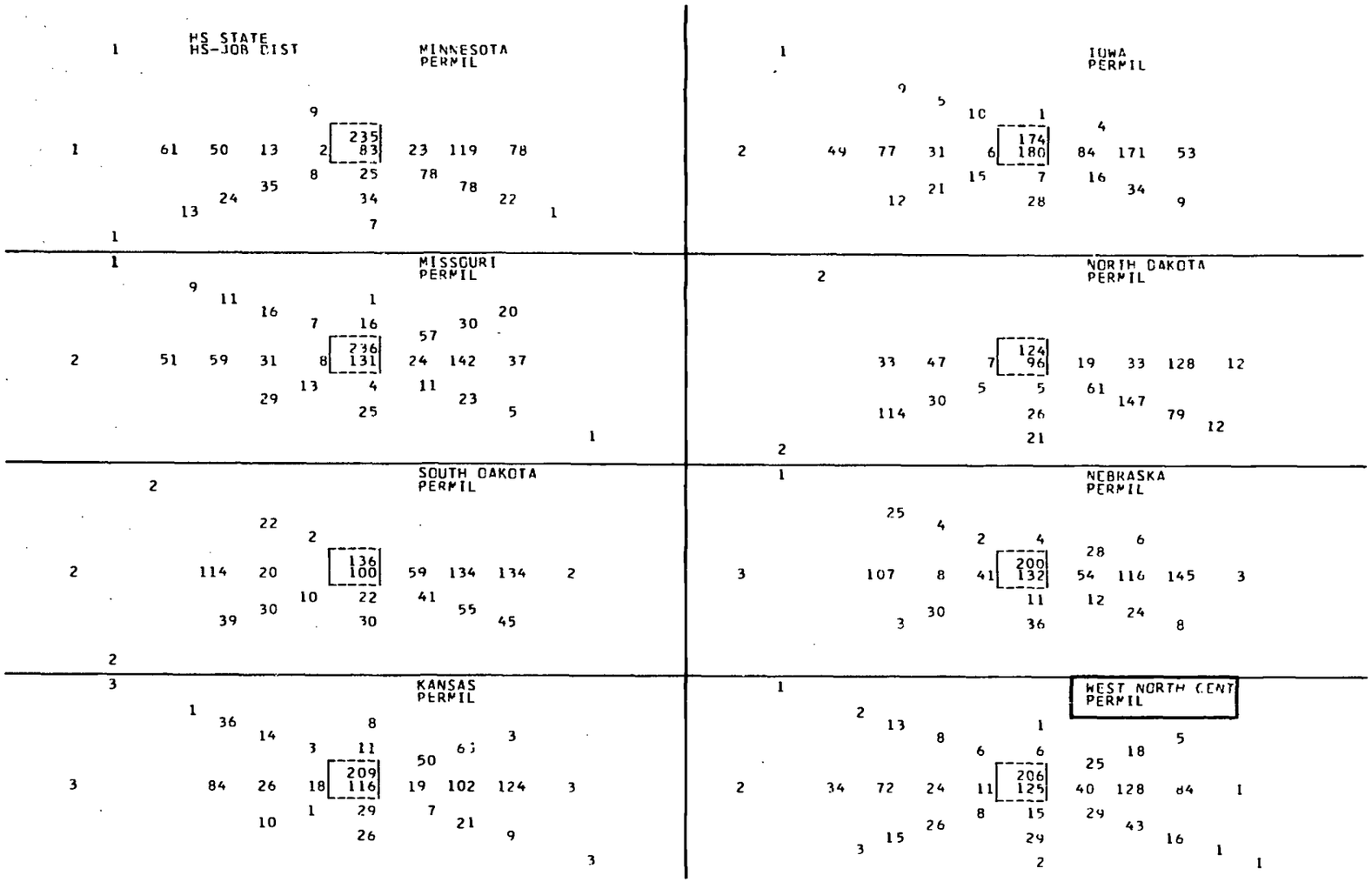


FIGURE C-2—Continued

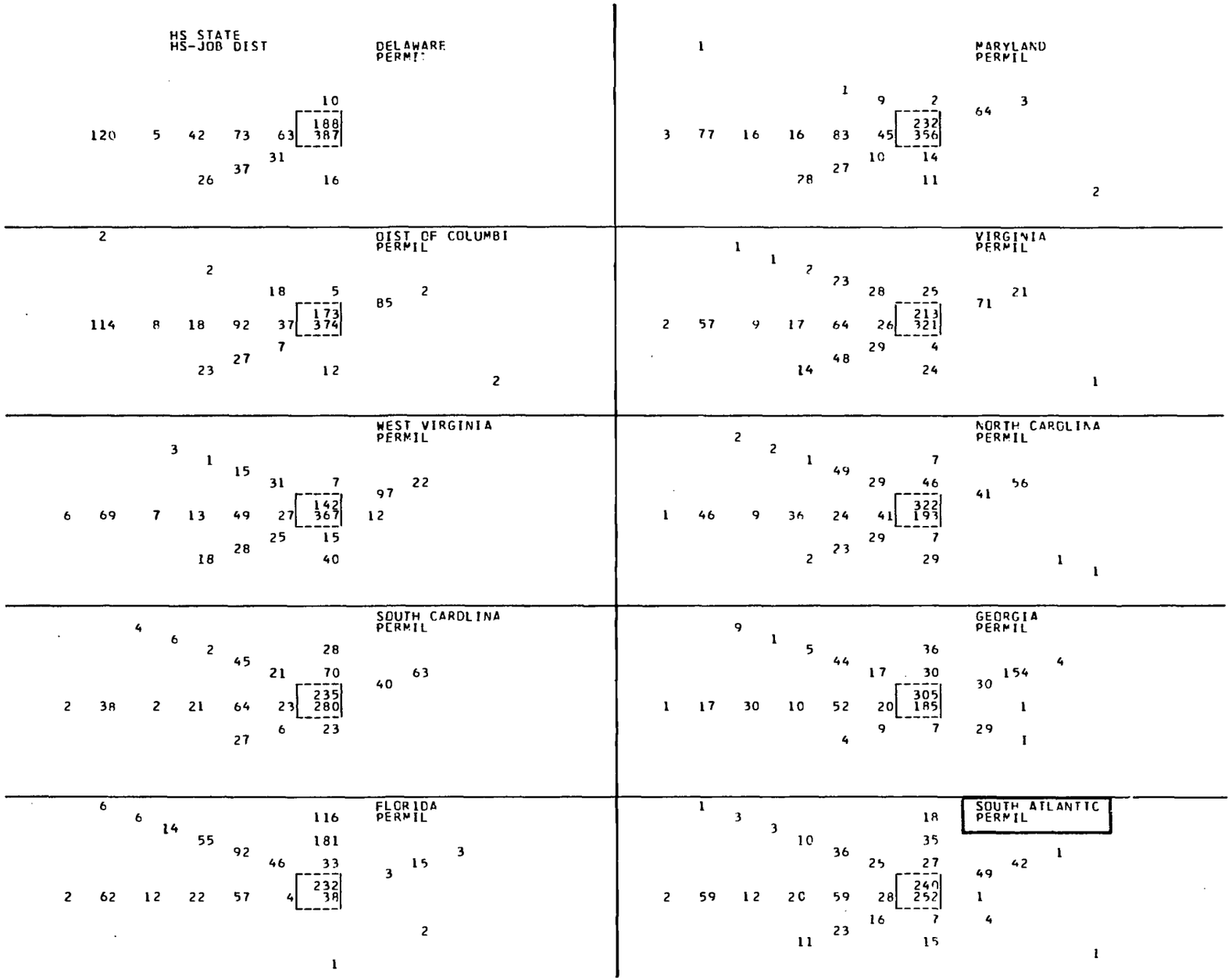


FIGURE C-2—Continued

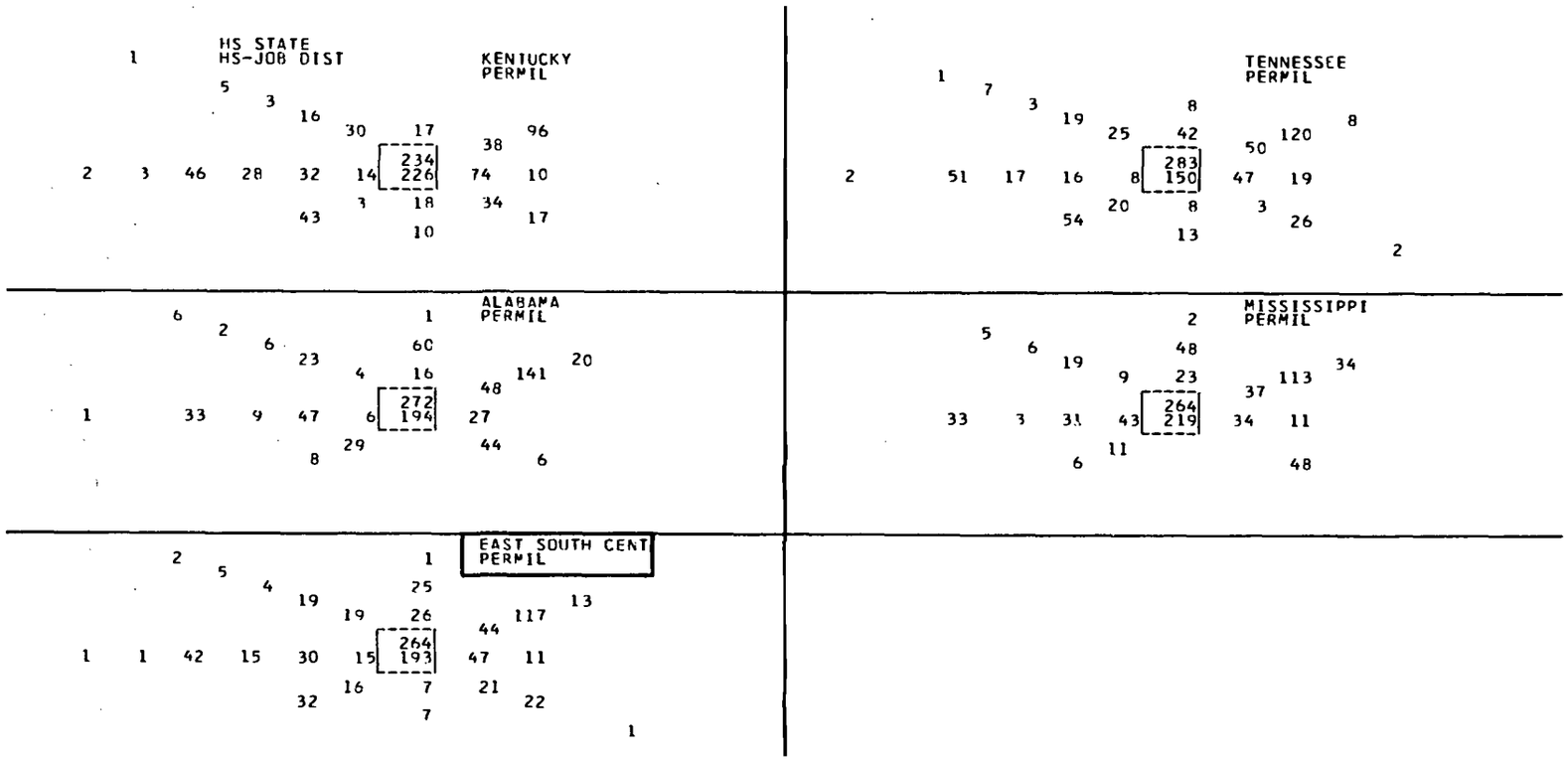


FIGURE C-2--Continued

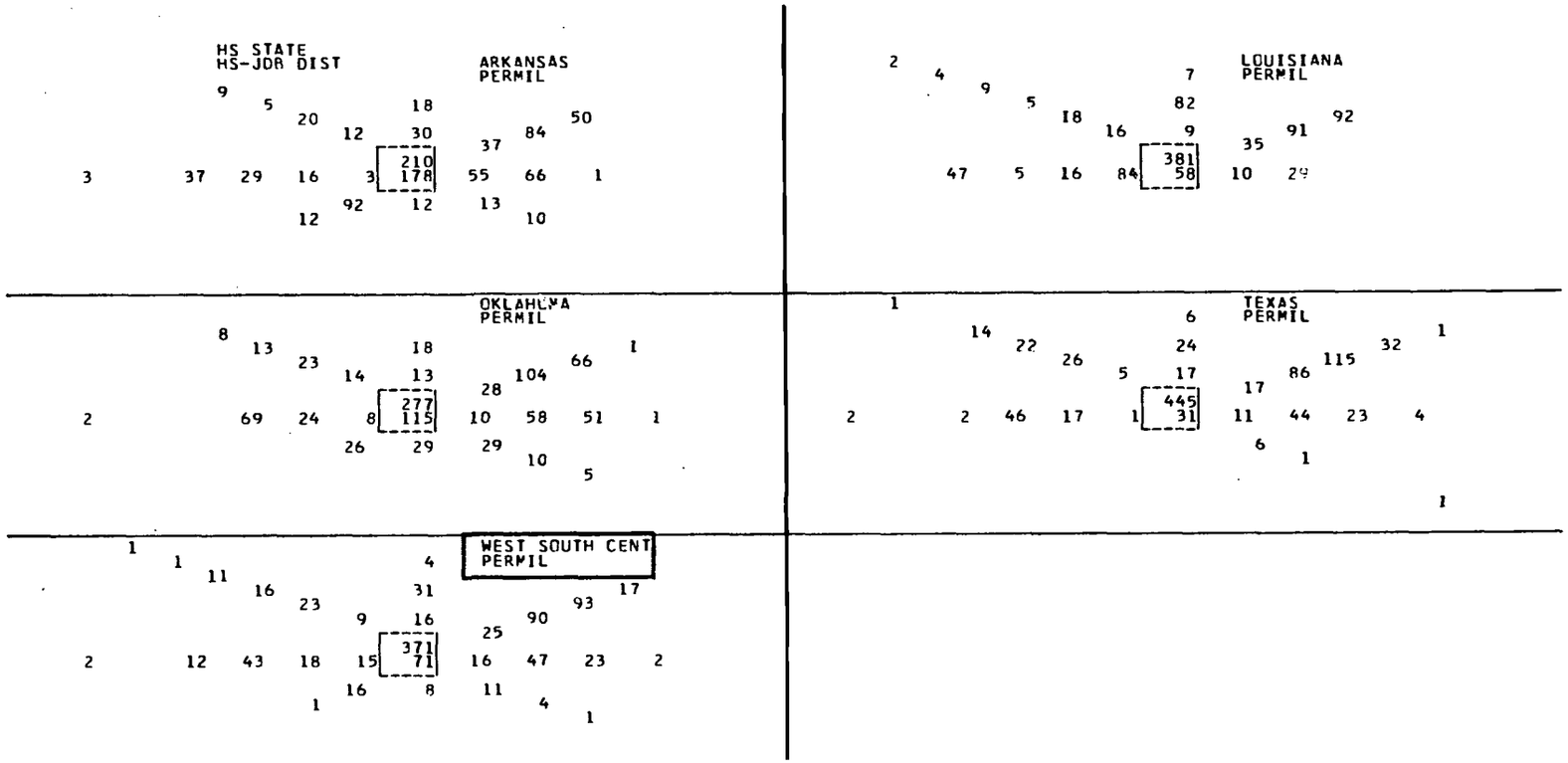
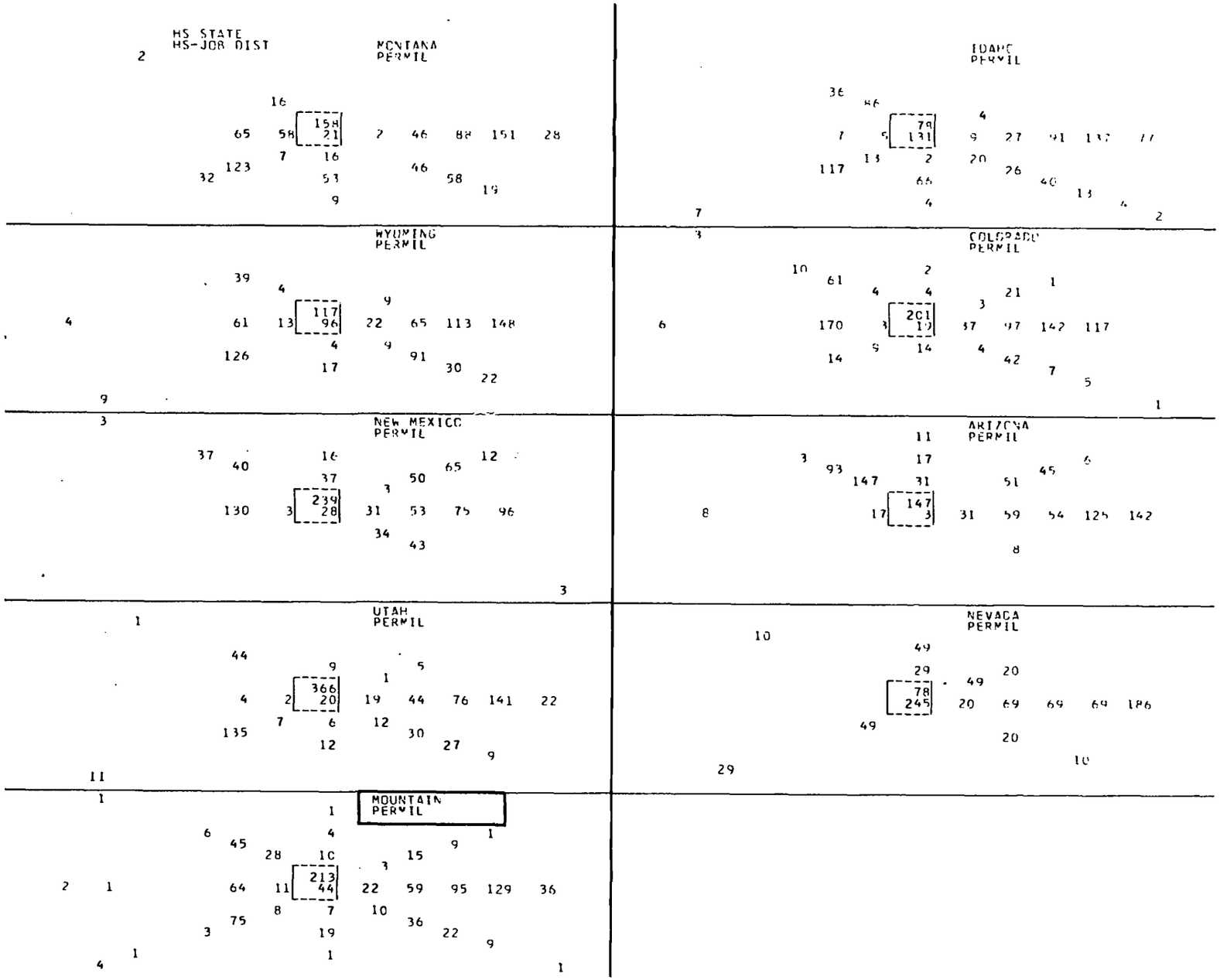


FIGURE C-2—Continued



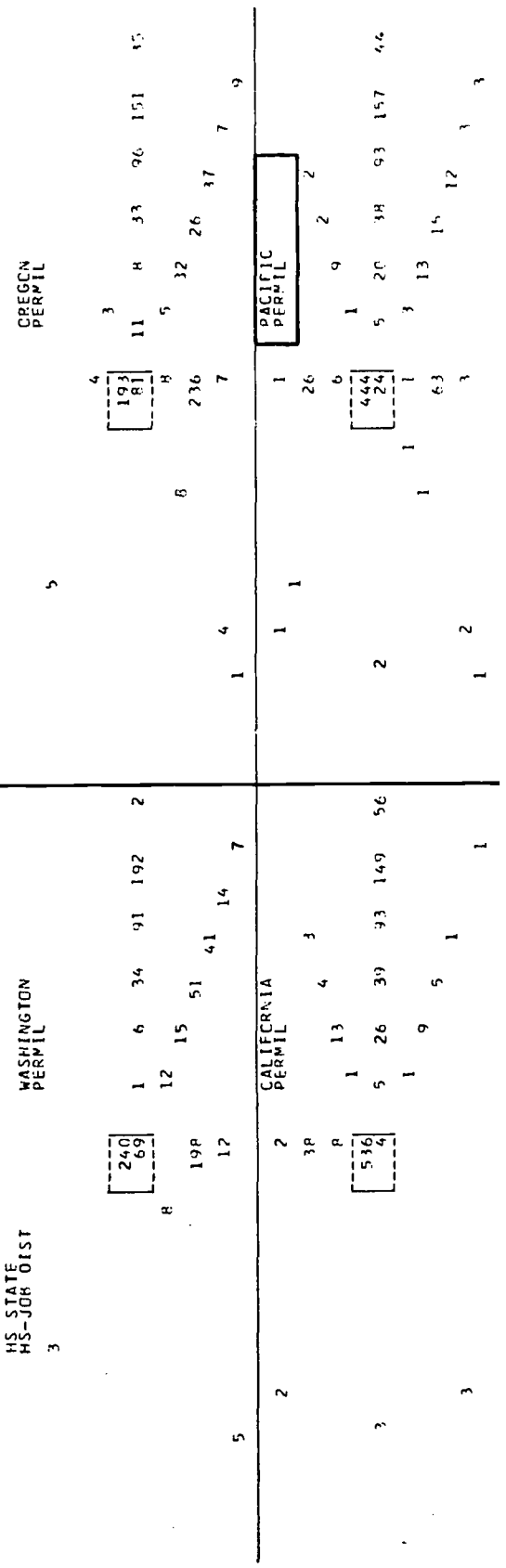


FIGURE C-2—Continued

APPENDIX D Set of "Block Diagrams," with Explanation: State-to-State Move Percentages at Each Career Stage

HOW TO USE THE BLOCK DIAGRAMS

Each block, or cell, has 12 percentage figures, representing all the state-to-state interchanges for a given pair of states at each career stage. There are six career transitions, with an origin and a destination percentage for each, making 12 percentages in all.

An example will be most useful in illustrating the information contained in the 2,601 blocks of this table (over 90 percent of which contain some data–less than 10 percent are blank because of less than 1 percent interchange at any stage). An example that most easily illustrates the whole table is from the last page, where vertical and horizontal total numbers may be found for some of the western states. Let us consider the interchanges between Oregon and California.

(1957-1967 CY PhD's)

		ORE. H	ORE. V	CAL. H	CAL. V	ROW TOT.
O						
R	H-B	74	65	8	1	1,145
E	H-P	22	20	19	2	1,145
	H-J	19	17	25	2	912
	B-P	24	24	17	2	1,306
	B-J	21	22	23	2	1,062
	P-J	30	31	17	2	1,056
C						
A	H-B	2	10	85	76	6,887
L	H-P	3	14	57	38	6,887
I	H-J	2	12	54	31	5,694
F						
	B-P	2	14	59	43	7,654
	B-J	2	11	55	35	6,325
	P-J	2	15	57	51	8,833
T						
O	H-B	1,306		7,654		
T	H-P	1,312		10,447		
A	H-J	1,008		10,016		
L						
	B-P	1,312		10,447		
	B-J	1,008		10,016		
	P-J	1,008		10,016		

Percentages are expressed to the nearest whole number, so when used as multipliers of marginal totals, the products may not check out exactly. The margin for such rounding errors is proportionately rather large for small percentages.

The left-hand column contains the state name or abbreviation, written vertically. The next column, with two letters separated by a dash, indicates the career transitions. H stands for high school, B for baccalaureate institution, P for PhD institution, and J for Job or post-PhD employment location. We have six such transitions:

H-B = state of high school to state of baccalaureate institution
H-P = state of high school to state of doctorate school
H-J = state of high school to state of post-PhD employment
B-P = state of baccalaureate to state of PhD
B-J = state of baccalaureate to state of post-PhD job
P-J = state of doctorate to state of post-PhD job

Skipping the body of the table for a moment, let us examine the data on total numbers. Under ROW TOT. at the far right, the number 1,145 indicates that 1,145 PhD's of the period CY 1957-1967 inclusive had their high school origins in Oregon. This number is repeated immediately below, as line 2 also refers to high school origins. The third number, 912, indicates that we have information on the post-PhD job location of only 912 of these 1,145 cases. (Data on job locations for the other 233 were not available.) The next number in the ROW TOT. column, 1,306, indicates how many 1957-1967 PhD's had their baccalaureate origins in Oregon. Below that, 1,062 indicates how many of this 1,306 provided data on their post-PhD job location. The final row total for Oregon, 1,056, indicates how many Oregon *PhD's* gave post-PhD job location data. Further down the ROW TOT. column, we find similar data for California.

Looking now to the bottom of the table, we have another set of totals, representing the numbers of 1957-1967 PhD's for whom these two states were destinations at each career transition. For Oregon, we see that 1,306 people either remained in or migrated to

Oregon to take bachelor's degrees. (This, it will be observed, agrees with the 1,306 for the BA-PhD transition in the ROW TOT. column.) Next we see that 1,312 people took their PhD's in Oregon, whatever their high school origins might have been. The third figure, 1,008, indicates the number designating Oregon as their post-PhD location. (Others undoubtedly located there but did not know at the time of filling out the Doctorate Survey that they would locate there.) The fourth figure, 1,312, repeats the second, again referring to Oregon PhD's, regardless of baccalaureate origin. The final two figures repeat the known job location numbers, here used with reference to baccalaureate and PhD sources. The same set of explanations, of course, applies to the California column to the right.

In the body of the table, percentages only are found, not raw numbers. Two percentages are found on each line within each block. For purposes of space-saving, these percentages are not separated, but written side-by-side, giving the appearance of a single four-digit number where two two-place percentages occur together. Starting with the upper left block, marked out with heavy lines to indicate Oregon as both origin and destination, we find, on line 1, 74 percent under the H and 65 percent under the V. This means that 74 percent of the raw total of 1,145 or 65 percent of the column total of 1,306 had Oregon as both high school origin and baccalaureate origin, in other words, remained in Oregon from high school to college.

The next pair of numbers, 22 and 20, indicate the percentage who remained in Oregon from high school to PhD: 22 percent of 1,145 (high school origin) and 20 percent of 1,312 (PhD origin). The third set of percentages, 19 and 17, refer to the proportions of Oregon high school graduates known to have chosen Oregon for post-PhD employment, based, as before, on the origins and destinations totals at the right and below. The fourth set of percentages, 24 and 24, are equal because the base numbers with Oregon as BA origin (1,306) and as PhD destination (1,312) are nearly identical. The fifth set, 21 and 22, are also nearly alike, based on 1,056 and 1,008, respectively. The sixth set, 30 and 31, are also similar; their bases are 1,056 and 1,008.

Coming on down the Oregon column to the intersection with California, the percentages change dramatically. This is, primarily, because of the vast differences in the state totals and, secondarily, because of a differential migration pattern. Thus in the H-B row we find 2 and 10 percent, indicating that 2 percent of California's 6,887 PhD-bound high school graduates took BA's in Oregon, but that this was 10 percent of Oregon's total BA production. The next pair, 3 and 14 percent, indicate that of California's 6,887 high school graduates who eventually took PhD's, 3 percent took them in Oregon, which was 14 percent of Oregon's 1,312 PhD's during the 1957-1967 period. The next pair of figures indicates that 2 percent of these people (out of the 5,694 with known job locations) settled in Oregon after the doctorate. The proportions moving from California baccalaureates to Oregon PhD's were 2 as origins and 14 percent as destinations, and from California BA's to Oregon jobs, 2 and 11 percent. California PhD's moving to Oregon for employment were 2 percent of California's PhD's and 15 percent of the Oregon-employed total.

The next pair of columns gives the percentages moving from Oregon as state of origin to California as state of destination. Here, of course, the magnitudes of the percentages are reversed, although the numbers of cases are probably not greatly different (The numbers are here omitted to make the table as readable as possible.)

The final box gives the data on California as both origin and destination. That is, it shows the percentage of California PhD-bound high school graduates who remain there for the BA, PhD, and eventual employment, and similar percentages for California BA's and PhD's. The percentages in this box are substantially larger than those for Oregon. This occurs for two reasons: California is much larger, hence a person would have to move farther to leave the state; and California is a strong magnet at all career stages, as indicated by the substantially larger numbers for California as destination vs. California as origin.

FIGURE D-1

Block diagrams of state-to-state migration percentages at each career stage.

ST NO		ME. H	ME. V	N.H. H	N.H. V	VT. H	VT. V	MASS H	MASS V	R.I. H	R.I. V	CONN H	CONN V	N.Y. H	N.Y. V	N.J. H	N.J. V	PA. H	PA. V	OHIO H	OHIO V	IND. H	IND. V	ILL. H	ILL. V	MICH H	MICH V	WIS. H	WIS. V	MINN H	MINN V	IOWA H	IOWA V	MO. H	MO. V	N.D. H	N.D. V	S.D. H	S.D. V	NEB. H	NEB. V	KAN. H	KAN. V	DEL. H	DEL. V	MD. H	MD. V	D.C. H	D.C. V	VA. H	VA. V	W.VA H	W.VA V
MAINE	H-B	6254		3	2	1	1	12	1	2	1	2		6				1		1				5		2																										
	H-P	230		1	6			21	1	3	2	4	1	17	1	3	1	5		2		5		5		5		5	1	1		2								1				1	2						1
	H-J	1420		3	4	1	2	16	1	1	1	5	1	11		3		6		4		2		2		2		2	1	1		1		2								1	1	3	1	2	1		
NEW	B-P	130		2	8		2	19	2	3	4	5	1	17	1	4	1	6	1	2		4		4		3		4	1	1		2		1								1	1						1
	B-J	1118		3	4	2	5	14	2	2	2	5	1	12	1	2		7	1	2		2		4		2		2	1	1		1		1								2	1	3	1	3	1		1
	P-J	24	2					12						16		4		16				4																						4					1
NH	H-B	2	2	3934		2	3	27	3	1	1	6	2	6		5	2	2		2				1		1																						1		
	H-P			211			2	26	2	2	2	6	2	14	1	4	1	6	1	2		2		5		5	1	3	1	1		2												2	1	3	1	1	1		
	H-J		1	610		1	3	18	2	1	1	4	1	12	1	6	1	5		3		2		4		2		2		1		1										1	1	2	1	5	1	2	1		1
	B-P		7	211			5	17	2	2	2	6	2	16	1	6	2	5	1	3	1	3		5	1	5	1	4	1	1		2												2	1	2	1	1	1		
	B-J	1	3	612		1	5	11	1	1	1	4	1	13	1	7	1	5	1	4	1	2	1	4	1	3	1	2		1		1		1								3	1	4	1	2	1		1
	P-J	4	1	9	2	1	1	13		2		2		6		2		16		2		1		3		4				1		1										1	3	9		2		1	1
VT	H-B	4	2	6	2	4836		15	1	1		3		5				3		3				1		1		1																							
	H-P		4		1	212		15	1	2	1	5		21		4		4		1		5		4		6		3		2		1												2		1		1			
	H-J	1	1	1	1	8	9	14	1	1		5	1	15		5		5		4		2		5		4		1		1		1												5	1	2		2			
	B-P			1	4	324		15	1	2	1	4		24	1	5	1	5		3		4		4		5		2		2		1												2		1		2			
	B-J			1	1	1014		12	1			3		20	1	5		6		5		3		4		1		1		1		2								1				3		1		3			
	P-J			6	1	14	3	11		3		11		6		6		9		3		3				3						3								3						3					
MASS	H-B	218		316		115		6745		215		410		5	2	1	3	2	1	2	1	1	1	1	1	1	1		1														1		2					
	H-P		4	129		7		3420		214		611		13	4	3	5	4	3	2	2	3	2	1	4	3	3	2	3													1		4		3			
	H-J	111		113		114		2821		111		510		12	4	4	4	6	4	3	3	2	2	3	2	3	3	1	2	1	2	1	2		2							1		4		5		4		2
	B-P			130		5		3834		116		614		13	6	3	9	4	4	2	2	3	3	5	4	3	4	2	4	1	3	1	2	1	2							1		3		6			
	B-J	114		116		115		2832		114		413		12	7	5	8	5	5	3	4	1	3	3	4	3	4	1	3	1	4	1	2	2								1		6		7		3	
	P-J	120		122		11		3950		116		311		8	5	4	6	4	5	2	3	1	3	3	4	2	3	1	4	1	3	1	3	1								1		6		9		5	
RHODE ISLAND	H-B	2	2	1	1	1	1	11	1	6652		2	1	4		1		2		1		1		1		1				1												2	1	1	1				
	H-P		4	1	4		5	18	1	1112		10	2	12		3	1	5		2		4		3		2		3		1												1	1	3	1	1	1		
	H-J	1	1			1	3	13	1	1517		7	2	9		4		8	1	2		2		2		3		1		1		1												1	1	1					
	B-P		4	1	6		5	16	2	1014		11	3	13	1	4	1	4		2		4	1	5		2		3	1	2	1	1		1										3	1	2	1	1	1		
	B-J	1	3	1	1	1		13	2	1319		7	2	9	1	5	1	7	1	3		2		2		3		2		1												4	1	3	1	1	1		
	P-J	1	2	1	1	1	3	12	1	1717		6	2	8		5	1	8	1	3				3		5	1	1				1										1		3	1	3	1	1	1		
CONN	H-B	2	6	2	5	1	6	17	5	2	6	4543		10	1	3	2	3	1	2	1	1	1	1	1	1																1	1	2	2	1	1		
	H-P		4		4		10	14	3	2	5	2014		18	2	3	2	5	2	2	1	3	1	5	1	4	1	2	1													1	1	2	2	1	1		
	H-J	1	6	1	5	1	5	11	4	2	6	1715		14	2	5	2	6	2	3	1	2	1	2	1	3	1	1	1	1	1	1	1									1	2	3	2	4	2	2	2	1	2
	B-P		7		2		5	13	3	1	3	2519		15	2	3	3	5	2	2	1	2	1	5	1	4	1	2	1	2	1	1	1											2	2	1	1	1	2		
	B-J	1	4	1	5		4	10	4	1	4	1716		13	2	5	2	7	2	3	1	1	1	3	1	2	1	1	1	1	1	1	1	1										2	2	4	3	2	2		1
	P-J	1	5	1	6	110		10	5	2	9	2430		11	2	5	3	5	2	4	2	2	1	3	1	2	1	1	1	1	1	1	1		1								1	2	2	4	3	2	3		1
NEW YORK	H-B		7	112		125		616		10		213		7283		211		3	7	2	6	1	5	2	4	2	5	1	4		1		2										1		5		1	7	116		4		4	
	H-P		11		15		29		920		118		423		4252		426		514		2		9		310		4		10		5		1										2		13		217		219		6		3	
	H-J		13		14		27		721		118		324		3551		832		616		310		1		8		310		311		1		8		1								1		7		5		115		317		320		110		8	
	B-P		7		9		15		714		118		317		4750		422		512		2		7		3		9		4		7		3		8								2		6		1		3		1	
	B-J		10		10		18		616		117		321		3848		929		614		3		9		1		7		3		8		1		6								1		4		13		214		218		5		1	
	P-J		16		14		26		4		9		114		317		4857		929		410		2		7		1		5		3		6		5								1		4		113		315		318		8		7	
	B-P		7		7		7		9		3		4		4		2220		6		2		1		1		1		2		1		1		1								1		2		110		214		218		110		9	
	B-J		3		1		2		7		3		2		2		2714		8		3		1		1		1		2		1		1		1								1		3		110		315		318		1		2	
	P-J		3		1		5		5		2		1		2		3319		8		3		1		1		1		1		1		1		1								1		3		2		2		3		2		2	
NEW JERSEY	H-B	1	5	1	7	1	7	7	4	1	5	3	5	15	4	3765		14	8	3	2	2	2	2	1	2	2		1														1		10		1	4	1	4		1	3		2	
	H-P		19		5		10		9		5		1		4		1423		9		6		3		2		2		4		2		1										1		1		8		3		5		2		3	
	H-J	1	7	1	6		4		7		5		5		5		2119		9		6		3		2		2		3		2		2		1								1		4		3		4		5		4		3	
	B-P		7		7		7		9		3		4		4		2220		6		2		1		1		1		2		1		1		1										3		3		2		2		2	
	B-J		3	1	5		2		3		2		2		1		2714		8		3		1		1		1		2		1		1		1								1		3		2		3		2		2	
	P-J		3	1	5		5		5		2		3		1		3319		8		3		1		1		2		1		1		1		1								1		3		2		3		2		2	
PENN	H-B		2		3		1		4		5		1		6		4		2		5		7		4		5		3		1		4		1										1		1		1		1		1		6	
	H-P		15		7		2		6		6		9		6		5		5		7		4		4		4		4		2		1		2										2		1		1		2		1		21	
	H-J		7		6		3		7		7		6		6		10		6		3		8		5		4		5		4		2		2										2		1		1		2		1		113	
NAVY	B-P		19		6		5		6		6		6		2		7		11		6		4		3		5		3		4		2		1										2		1		1		2		1		17	
	B-J		7		8		5		5		6		5		2		7		10		6		3		3		2		4		1		1		1										2		1		1		2		1		110	
	P-J		5		4		5		3		3		1		3		4545		7		9		4		5		3		4		2		2		2										2		1		1		2		1		111	

FIGURE D-1—Continued

ST NO		N.C. H	N.C. V	S.C. H	S.C. V	GA. H	GA. V	FLA. H	FLA. V	KY. H	KY. V	TENN H	TENN V	ALA. H	ALA. V	MISS H	MISS V	LA. H	LA. V	ARK. H	ARK. V	OKLA H	OKLA V	TEX. H	TEX. V	N.M. H	N.M. V	ARIZ H	ARIZ V	UTAH H	UTAH V	NEV. H	NEV. V	MONT H	MONT V	IDA. H	IDA. V	WYO. H	WYO. V	COL. H	COL. V	WASH H	WASH V	ORE. H	ORE. V	CAL. H	CAL. V	AKA. H	AKA. V	HAW. H	HAW. V	ROW TOT.
MAI	H-B																																																		
	H-P	2			1			2																1																												505
	H-J	1		1	1	1		2	1			1						1				1		2				1						1	1	1	1			2		1		4						505
																																						1		1		1		2		1				400
NE	B-P	3	1		1			2										1						1										1						2		1		3						583
	B-J	1		1	1	1		1				1						1						1												1				1		1		3				1		484
	P-J	8										4												4																												25
NH	H-B	1																																					1												653
	H-P	2	1					1				1												1																1				6				1		653
	H-J	1		1	1	1		1		1		1												2				1	1	1										1		2	1			7		1				524
	B-P	3	1									1	1											1				1	1	1										1	1	1	1			7		1		751
	B-J	2	1			1		1				1												1		1						1				2				2	1	2	1			8	1	4		1		620
	P-J							1						2				3				1		2										1						2		1				4						94
VT	H-B	1						1																																		1				3						277
	H-P	2						2				1												2																												277
	H-J	2						1				1												2								1								1		2		1		6						222
	B-P	2				1		1		1		1												1		1	1	2	1											1		2		1		4						368
	B-J	1						1				1										1		2																1		2		1		6						282
	P-J	3																																													11						35
MAS	H-B		1				1		1		1				1								1				1		1						2												2	1	4				4450
	H-P	2	3		2		1	1	2		1		1		1			1				1		1		2		2		1				1		2		2		1	2		2		5	2			4		4450
	H-J	1	2		2	1	2	1	3		1	1	2		1	1		1		1		1		1		1		2		1		1		2		2		1		1	2	1	2		7	3		6		5	3527
SS	B-P	1	3		2		2		2		1		2		1		1		1		1		2		1		2		2		1				4				1		1	2		2	8	5			6		6657
	B-J	1	3	1	2	1	2	1	3		2	1	3		1	1	2		1		2		1		2		2		2		1		1		2		2		1	3	1	4		2	11	6	5		6		5283
	P-J	1	3		2	1	3	1	2		1	1	3		1	2		2		1		1		1		2		3		2		1		1		2		1		1	4		2	9	5	4		5		5912
RI	H-B																																																				
	H-P	2			1			1				1				1		1						1																								2						563
	H-J	2				1		1		1								1						2		1																1		1		7				1	1	563
	B-P	2			1			1				1												1																												439
	B-J	2	1			1		1		1	1													1																1		2	1			6				3		712
	P-J	1						1				1						1						2		1	1							1	1	1				1		2	1	1	1	7				1		579
																																													1	1	8						429
CONN	H-B																							1				1																								
	H-P	2	1		1		1	1	1		1	1	1									1		1	1		1		1										1	1	1	1	1				5	1					1886
	H-J	2	1		1		1	1	1	1	1	1	1		1									2	1	1	1		1		1				1				1	1	1	1	1				8	1		2		1	1886
																																																			1487
NN	B-P	2	2		1		1	1	1							1								1				1																								
	B-J	1	1		1		1	1	1	1	1	1	1											2	1	1	1		1						1				1	1	1	1					8	1					1962
	P-J	1	2		1	1	2	1	1		1	1	1		1		1					1	1	2	1	1	2		1		1				1		1		1	1	1	1	1		1		9	1		1		1	1597
																																													1	1	7	1				2	2130
NY	H-B		4		2		3		6		1		1		2		2		2		1		1		1		3		3		1		1		2		2				5		1		1	3		8			116923
	H-P	1	8		4		5	1	9		6		4		2		2		4		3	1	4		4		9		7		3	25	5		2		4		2		5	1		6	1	5		6		9		6		716923
	H-J	1	7		4		5	1	9		6	1	5		3		3		5		3	1	4		4		8		6		2				4		5		1	1	7		1	6		8	1	1		7		813817
	B-P	1	6		2		3	1	7		4		4		1		3		1		2		2	1	3		7		6		3	25	5		3		4		2		3	1		4	5	7		11			614577
	B-J	1	6		3		4	1	8		4		4		2		2		3		1		2	1	4		7		5		2		3		4		3		1	7		4	1	5	7	9		7			711959
	P-J	1	6		4	1	6	1	7		6	1	4		6		4		3		3		2	1	3		5		4		3		4		4		4		3	1	4		1	5	6		9			1011350
NJ	H-B	1	2		1		1	1	2		1		1		1		1		1								2		1						1		1		1						1	1	1						3976
	H-P	1	2		2		1	1	3		2	1	2		1		1		2			1	1	1	1		2		2		1				1				1		1	2		1	6	2		17		1	3976
	H-J	1	3		1	1	1	1	3		1	1	2		1		1	1	2		1		1	1	1	1	2		2		1		2		1		1		2		1	2		1	7	2		1		4	3166
	B-P	1	1		1		1		1		1		1						1				1	1	1		1								1						1				7	1		6			2305
	B-J	1	1		1		1		2		1	1	1		1			1	1				1	2	1	1	2	1						1		1				1				8	1			2		1875
	P-J	1	2		1		1		1		1	1	1		1				1				1	2	1	1	2			1			2		1		1		1		1	1		1	7	1		1		2	2046
PEN	H-B	1	2		2		1		3		2		2		2				1				2	1	2		2		4		1				2		1		1		2		1		1	1		15		1	7498
	H-P	2	5		2		2	1	4		3	1	3			1		1	3			2		2		3		4		1				2		2		1	2		1	3		1	4	3			1	7498
	H-J	1	5	1	3	1	5	1	3	1	4	1	3		2	1	3	1	4	1	4		2	2	3	1	4	1	4		1				3		2		1	3		1	3		1	3	6	4		9		3	6078
NA	B-P	2	4		1		2	1	3		2		2		1		1		2		1		1	1	2		2		4		1		?				2		1	2	1	3		1	4	3			1	7266
	B-J	1	4	1	3	1	3	1	4		3	1	3		3		2	1	3		1		1	1	2		3		4		1		?				3		1	3	1	3		1	5	3			6		5868
	P-J	1	4		3	1	3		1	1	3	1	3		2		1	1	2		1		2	2	2		2		3		1		1		2		2		2	1	2	1	3		1	4	2		5		2	4910

FIGURE D-1—Continued

ST NO		ME. H	ME. V	N.H. H	N.H. V	VT. H	VT. V	MASS H	MASS V	R.I. H	R.I. V	CONN H	CONN V	N.Y. H	N.Y. V	N.J. H	N.J. V	PA. H	PA. V	OHIO H	OHIO V	IND. H	IND. V	ILL. H	ILL. V	MICH H	MICH V	WIS. H	WIS. V	MINN H	MINN V	IOWA H	IOWA V	MO. H	MO. V	N.D. H	N.D. V	S.D. H	S.D. V	NEB. H	NEB. V	KAN. H	KAN. V	DEL. H	DEL. V	MD. H	MD. V	D.C. H	D.C. V	VA. H	VA. V	W.VA H	W.VA V
OHIO	H-B			2		2		3	2	2		1	3	2	1	1	1	2	1	7469		4	6	3	2	3	3	1			1		1											1	2	2			2
	H-P			4		10		5	3			2	4	7	3	1	2	4	4	3442		6	7	7	5	7	6	3	4	1	2	2	3	1	2	1								1	3	2	4	1	3			3
	H-J	2		5		4		4	3			1	4	7	3	2	3	4	4	2831		4	7	5	5	6	7	2	4	1	3	1	4	1	3	1								2	4	2	4	1	3	1	6
	B-P			3		7		4	4	5		2	5	8	3	1	3	4	4	3445		6	7	7	5	7	7	3	5	1	2	2	3	1	3									1	4	1	4		3		2
	B-J	4		6		4		4	4	5		2	5	8	4	2	3	5	5	2732		3	7	5	5	5	7	3	6	1	3	1	4	1	6									2	4	2	4	1	4	1	8
	P-J	3		2		2		2	1	1		1	2	5	2	2	2	5	3	4237		2	3	3	0	4	4	1	2	1	1	1	2	1	1									1	2	1	2	1	2	1	9
IND	H-B			1				2	1			1	1	1						4	2	7456		2	2	2	1					1	1												1						
	H-P			1				4	1	2		2	2	5	1	1	1	2	1	5	3	3820		10	3	6	3	3	2	1	1	2	2											1	1	1	2				
	H-J	3		2		3		3	2			1	2	6	1	2	1	3	1	6	4	2222		8	4	5	3	2	2	2	2	2	3	1										2	2	2	2	1	2	1	3
	B-P			3				3	2	2		2	3	5	1	2	2	3	2	5	4	3625		10	4	6	4	3	2	1	1	2	3	2	3									1	2	1	2		1		3
	B-J	3		2		2		4	2	3		2	3	5	2	2	2	4	2	7	5	2127		8	5	5	4	2	3	1	3	2	3	2	5									2	3	2	2	1	2	1	4
	P-J	6		4		2		3	3	4		1	3	6	3	3	4	4	3	2139		7	6	4	4	3	5	1	4	2	5	2	5	6		1	3							2	4	1	3	1	4	1	6
ILL	H-B			2		1		2	3			1	2	1	1		1	1	2	3		611		6572		3	4	3	9	2	4	3	9	3	7									1			2		1		1
	H-P	4		2				5	5			1	3	5	3		1	4	2	4		710		3432		5	7	4	8	2	6	4	9	3	10									1	4		1		3		2
	H-J	5		5		2		3	4			2	5	6	4	2	4	4	3	5	1	512		2431		5	8	3	10	2	6	2	8	3	10			1	5	1	6	1	7	2	5	2	6	1	4		7
	B-P	4		1				4	4			1	3	6	3	1	3	2	2	3		6	7	4034		5	6	4	7	2	5	4	8	2	7									1	3		3		2		
	B-J	3		5		2		3	4			2	5	7	4	2	4	4	4	5		9	7	2732		4	7	3	8	1	4	2	7	3	8									2	5		4		4		
	P-J	5		5		3		3	4			1	5	7	5	3	5	4	6	4	1	411		3041		4	7	3	9	2	7	1	6	2	7									2	5		5		5		7
MICH	H-B			1				2	1			1	2	1	1			3	2	2	2	2	2	3	2	8173		1	1	1	1	2	3	1	2									1	1		2		1		2
	H-P			2				4	2			1	2	5	1	1	2	3	2	3	3	4	3	7	4	4832		3	3	1	2	3	4	1	2									1	2		3		2		4
	H-J	3		3		3		3	2			1	2	7	2	2	2	3	2	5	4	3	4	5	3	3330		3	4	2	3	1	3	1	1									1	2		3		2		4
	B-P			2		2		4	2			1	2	5	2	1	2	2	2	2	4	4	4	7	4	4836		4	4	1	2	2	4	1	2									1	1		2		1		2
	B-J	5		2		3		3	3			1	2	7	2	2	2	3	2	6	5	3	4	5	4	3333		3	5	1	3	1	4	1	2									1	2		3		2		4
	P-J	5		6		3		3	3			2	4	6	3	2	2	3	3	6	5	5	6	3	5	3547		2	5	1	4	1	5	1	3									2	3		3		3		5
WISC	H-B			1				2	1				1	1				2	1	5	2	2	2	5	2	2	1	7278		4	5	2	2	1	1											1							
	H-P							3	1	1		1	1	1		1		2	1	3	2	4	2	10	4	5	3	3427		5	6	4	4	2	3									1	2	2	3		1				
	H-J	1		2		2		3	2	1		1	1	2	1	1		4	3	3	3	8	4	5	3	2326		5	7	2	4	2	3	1	6									2	2	2	2	1	1		1
	B-P							3	1	2		1	1	5	1	1	1	2	1	2	1	1	1	3	1	3827		4	4	5	4	1	2	2	4									1	2	2	2		1		
	B-J	2		1		2		3	1	1		1	1	6	1	2	1	3	1	4	2	3	2	8	4	2525		4	6	2	3	2	3	1	6	1	4	1	2		1			2	2	2	2		1		2
	P-J	5		4		3		3	2	1	4	1	1	6	2	3	2	4	2	4	3	3	3	5	3	2231		3	5	2	4	1	3	1	4	1	3	1	5		1			2	2	2	2	1	2		3
MINN	H-B			1				2	1			1	1	1				1		2	1	1		2	1	1	1	7873		3	3	1	1			211		1	6		1							1					
	H-P							4	1	1		1	1	4	1	1	1	2	1	3	2	2	2	6	2	4	2	4	3	6	5	1	2			230		12		1	3					1	2	2	2		1		1
	H-J	2		2		1		3	1			1	1	5	1	2	2	3	1	3	2	2	2	6	3	4	2	5	5	3	5	2	3	1	2	215		1	8	1	3			1	2	2	2	1	1		1
	B-P							3	1			1	1	5	1	1	1	2	1	1	1	3	2	6	2	4	2	5	4	3	5	4	2			229		8		1	4			1	1	1	2		1		1
	B-J	2		2		1		3	1			1	1	5	1	2	1	3	1	2	2	3	2	6	3	4	2	5	4	2	6	3	5	1	2	113		9		1	2			2	2	2	2		1		2
	P-J	2		2		1		2	1			1	1	5	1	2	1	3	1	1	1	5	2	4	3	2	2	4	4	3	6	2	4	1	2	1		7		1	2			2	2	2	2	1	1		2
IOWA	H-B							1				1		1				1	1	4	1	1	1	1	1	1	1	3	3	7671		2	2					1	4	3	5		1										
	H-P							3	1			1	1	1				2	1	5	2	4	3	6	2	4	2	3	3	3526		2	3				2	119		3	9	1	3			1	1	2	1		1		1
	H-J	1		1				2	1			1	1	5	1	2	1	2	1	4	2	3	2	7	3	4	2	3	4	1726		3	4	1	6			1	8	2	7	1	3	1	1	2	1	1	1		1
	B-P							3	1			1	1	5	1			1	1	2	1	6	3	6	2	4	2	3	2	4	4	3729		2	3				3	120		2	6	2	3		1	1	1	2		1		2
	B-J	2		2				2	1			1	1	5	1	2	1	3	1	4	2	4	3	7	3	4	2	4	5	3	4	1829		3	4	1	7		1	8		2	6	2	3	1	2	1	2	1	2		1
	P-J	3		3		1		1	1			1	2	3	1	2	1	3	2	8	4	3	3	4	5	4	3	5	5	2	4	2143		3	4	1	6		1	9		2	7	2	5	1	3	1	2	1	1		3
MO	H-B			1				3	1			1	1	1	1			2	1	4	2	1		1	1			1	1	6773										1	1	5	8					2					
	H-P			2		2		4	1			1	1	4	1	1	1	2	1	2	3	9	3	3	2			3	2	1	2	2838										1	3	4	10			1	1	1	2				
	H-J	1		2		3		2	1			1	1	5	1	2	1	2	1	4	2	2	2	7	4	3	2	2	2	1	2	2431		2		3				1	3	4	7	1	2	2	2	2	1	1		2
	B-P			1		2		2	1			1	1	4	1	1	1	2	1	2	1	4	2	8	3	3	1	3	2	1	1	3342								1	4	4	8			1	1	2	3		1		
	B-J	1		1		2		2	1			1	1	5	1	2	1	2	1	3	2	3	2	7	3	3	2	2	2	1	2	2733		1		1	5			1	4	4	7	1	1	2	2	2	1	1	2	1	3
	P-J	1		2		2		2	1			1		4	1	1		2	1	3	2	1	2	7	3	3	1	3	2	1	1	3433		3		1	4			1	2	3	5	1	1	1	1	1	1	1	1		1
ND	H-B							1						1				1		2		1		2		1		1		20	4	1				5883		1	2	1						1					
	H-P							3				1		4		1		1		4		1		4	1	6	1	4	1	9	2	1				1237		1	5	2	1	2	1			1					
	H-J							3				1		4		1		2		4		2		5	1	4	1	4	1	11	3	2	1	2		1224		2	3			1		2		3	1				
	B-P							2				1		3				2		2		5		3		8		5	1	8	1	7	1	2		1939		1	5	1		2	1			1					
	B-J							3						4		2		2		3		2		5		3		5	1	8	2	2	1	2		1724		3	3	1		1				2					
	P-J	1												4				1		1		3		3		3		5		20	2	2		1		2316		3	1	1		2						2		1	

FIGURE D-1—Continued

ST NO		N.C. H	N.C. V	S.C. H	S.C. V	GA. H	GA. V	FLA. H	FLA. V	KY. H	KY. V	TENN H	TENN V	ALA. H	ALA. V	MISS H	MISS V	LA. H	LA. V	ARK. H	ARK. V	OKLA H	OKLA V	TEX. H	TEX. V	N.M. H	N.M. V	ARIZ H	ARIZ V	UTAH H	UTAH V	NEV. H	NEV. V	MONT H	MONT V	IDA. H	IDA. V	WYO. H	WYO. V	COL. H	COL. V	WASH H	WASH V	ORE. H	ORE. V	CAL. H	CAL. V	AKA. H	AKA. V	HAW. H	HAW. V	ROW TOT.
OHIO	H-B		1		1		1		2	1	2		1		1								1	1	2		4	1	3				1			1			1		1		1	1	4		1	5391
	H-P	1	3		1		2	2	5		3	1	2		2		1		2				1	2	2		4	1	4		1			1	2			2	1	3	1	2	1	2	6	3			4	5391
	H-J	1	3		3	1	3	2	5	1	6	1	4		2		2	1	3		1	1	3	2	2	1	3	1	5		1	6		2		2		2	1	4	1	4	1	2	9	4	2		3	4278
	B-P	2	3		1		1	2	5		3		2		1		2		1				1	2	3		3		5		1						2	3	1	3	2	4	5	3			6		7	5779
	B-J	1	3		2	1	3	2	5	1	6	1	4		2		1	1	3		1		1	2	3		4	1	5		1	6		2		2		1	1	5	1	4	1	3	8	3		2	4	4563
	P-J	1	3		3	1	3	2	4	1	6	1	3	1	3		1	1	2		1	1	2	2	2	1	3	1	4		1	6		3		1		2	3	1	2	1	2	5	2			4	3441
IND	H-B		1		1		1		2	1	3		1		1				1		1				1		1		1								1	1					1						2687
	H-P	1	1		1		1	2	3	1	3	1	1		1		1		1		1	1	2		1		1	2	3				1		2		1	1	2	2	1	1	1	2	6	2			3	2687
	H-J	1	1		1	1	2	2	3	2	4	1	2	1	3		1	1	1		1	1	2	3	2	1	3	1	3		1	2		1		1		1	1	2	2	3	1	1	8	2	1		3	2224
	B-P	1	2		1		2	1	3		3	1	2		1				1		1	1	2	1	2		3	1	2		1			1		2		1	2	2	1	2	1	2	6	2			3	3532
	B-J	1	2		2	1	2	2	3	1	5	1	2	1	3		1		1		1	1	2	3	2	1	4	1	3		1	4		2		1		1	2	2	3	1	2	1	3	9	3		1	3	2923
	P-J	2	4	1	4	1	4	1	4	2	9	1	4	1	5		4	1	4		4	1	5	3	4	1	3	1	5	1	4		3		4		4		2	1	4	1	3	1	3	7	3		1	3	4241
ILL	H-B		1		1		2		2		2		1		1		1		1		1		1	1	1		3		7		1		1		1		1		2	1	5			1	2	2		4	1	7306
	H-P	1	3		1		2	1	4	1	3	1	3		2		3	1	3		1	1	3	1	2	1	5	1	6		2		1		2		1		2	7	1	4	1	4	8	5		6	4	7306
	H-J	1	4		3	1	3	2	6	1	6	1	5		3		4	1	4		4	1	4	2	4	1	5	1	9		2		3		3		6		3	2	6	1	4	1	5	11	6		2	4	5926
	B-P	1	2		1		2	1	4		3	1	3		2		2	1	3		1	1	2	2	3	1	4		4		2	6		1	3		4	2	6	1	4	1	4	7	4			4	6634
	B-J	1	4		2	1	3	1	5	1	5	1	4		2		3	1	3		1	1	4	1	4	1	8		3		1	5		1	4		3	1	5	1	4	1	5	10	5		4	5	5312
	P-J	1	5		4	1	4	1	5	1	8	1	6		3		5	1	3		5	1	5	3	4	1	7	1	6	1	5		6		5		4		5	1	5	1	4	8	5		4	6	6320
MICH	H-B		1		1		1		1		1		1												1		2		1								2		2		1				2	1				3961
	H-P	1	1		1		1	1	1		2		1				1								1		2		3								4		2		1		1	3	2	1			4	3961
	H-J	1	2		1	1	2	1	2		2	1	2		1		1		1		1	1	2	1	1	1	3	1	3		1		1		2		2		1	2	4	1	2	1	3	10	3		2	2	3140
	B-P	1	1		1		1	1	2		2		1		1		1		1		1		1	1	1		2	1	3		1		2		2		4		1	2	2	1	3	1	2	6	3		6	4	4432
	B-J	1	2		2	1	2	1	2		2	1	2	1	1		1		1		1	1	2	1	1	1	4	1	3		1		3		2		3		1	3	3	1	3	1	2	9	3		4	2	3502
	P-J	1	3		3	1	3	1	3		3	1	3	1	3		2	1	3		2	1	4	2	2	1	3	1	5	1	5		5		4		5		3	1	5	1	3	1	4	7	3		5	5	4565
WISC	H-B								1																																									3	2951
	H-P	1	1				1	1	1		1	1	1						1		1	1	1	1	1		1	1	3		1		1		2		1		4		3	1	2		1	5	2			1	2951
	H-J	1	1		2	1	1	1	1		1	1	1		1		1	1	1		1	1	1	2	1	1	2	1	3		1		4		3		2		4		2	2	1	2	4	1	2	8	2		2	3	2302
	B-P	1	1				1	1	1		1								1		1		2	1	1		1	2	3		1		3		2		5		3	4	1	2	1	2	5	1				2723
	B-J	1	2		1		1	1	1		1				1		1	1	1		1	1	2	1	1	1	2	1	3		1		4		2		4		2	3	1	2	1	2	7	2		1	1	2119
	P-J	2	3	1	4	1	2	1	2	1	2	1	2	1	3		1	1	2		2	1	1	3	2	1	3	1	3	1	3		4	1	6		4		2	1	3	3	5	2	5	6	2		4	4	2883
MINN	H-B																																																		
	H-P	1	1					1	1			1	1						1		1				1		2		3				1				1	1	4	1	2	1	1	2	1	7	2		4	1	2648
	H-J	1	1		1	1	1	1	2		1	1	1		1			1	1		1	1	1	2	1	1	3	1	3	1	1		1	1	5	1	4		3	2	3	1	2	1	1	10	2		6	1	2648
	B-P	1	1					1	1										1		1				1		1		4				6				4		3	4	2	3	1	2	7	2		2	1	2115
	B-J	1	1		1		1	1	1		1				1			1	1		1	1	1	2	1	1	3	1	3				4		4		2		3	2	4	1	2	1	2	8	2		6	1	2812
	P-J	1	1		1	1	1	1	1	1	2	1	1		1		1	1	1		1	1	1	3	1	1	2	1	2		1		1		4		3		2	3	2	4	1	2	9	2		5	1	2231
																																																	4	2	1807
IOWA	H-B																																																		4		2389
	H-P	1	1			1	1	1	1		1	1	1						1		1	1	2		1		1	2	3		1		1				1		4		1	1	2		2	6	1		6	1	2389
	H-J	1	1			1	1	1	1	1	2	1	1		1		1	1	1		1	1	1	1	3	1	2	1	3		1	1	7		1	1	5		4	3	3	2	2	1	2	10	2		1	1	1907
	B-P	1	1		1		1	1	1		2		1		1		1		1		1	1	2		1		1	2	4		1				3		2	4	5	4	4	1	1	1	2	5	1		1	2	2550
	B-J	1	1		1	1	1	1	1	1	2	1	1		1		2	1	1		1	1	2	3	2	1	4	1	5		1		4		2	1	4		2	3	1	2	1	2	8	2		4	2	2032
	P-J	1	2		2	1	2	1	3	1	3	1	3	1	2	1	3	1	3		3	1	2	4	3	1	5	1	3		2		3		3	1	5	110	2	4	2	3	1	2	7	2		5	3	2579
MO	H-B								1		1		1		1		2			1	5		1	2	2		1	1	4		1	3						1	1	2					1	1			8		2863
	H-P	1	1		1		1	1	2		1		2		1		2	1	2	1	8	2	3	2	2		4	1	3		1				2		3		3	4	1	2	1	1	7	2				2863
	H-J	1	1		2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	3	2	3	5	3	1	3	1	3		1		4		2		3		3	2	4	1	2	1	2	9	2		2	1	2305
	B-P	1	1		1		1	1	2		1		2		1		2	1	2	1	7	2	3	2	1		3	1	2		1				2				3	3	1	1	1	1	6	1				2648
	B-J	1	1		1	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	3	2	3	4	3	1	3	1	3		1		3		2		3		3	2	3	1	2	1	1	7	2		1	1	2146
	P-J	1	1		1	1	1	1	1	2	4	1	1	1	2	1	2	1	2	1	5	2	2	4	2	1	1	1	3		1		3		2		3		1	1	1	1	1	1	1	5	1		1	2	1672
NDAK	H-B																							1								1		1		1		2		1				1		2					538
	H-P	1						1														2	1										3	1	9	1	4		1		1		3	1	2		6			1	538
	H-J	1						1				2	1					1						2		1	1	1	1					2	4	2	2	1	2	3	1	4	1	1	2	1	10		1			429
	B-P	2				1		1														2		1		1						3	7				1	1	5	1	3	1	5							372
	B-J	1						1		1		2						1						2		1	1						3	3	1	1	2	3	1	3	1	1		9			1			303
	P-J											2		1								1		3		1		1					2	1		1	1	1		3				6						147

FIGURE D-1—Continued

ST NO		ME. H	ME. V	N.H. H	N.H. V	VT. H	VT. V	MASS H	MASS V	R.I. H	R.I. V	CONN H	CONN V	N.Y. H	N.Y. V	N.J. H	N.J. V	PA. H	PA. V	OHIO H	OHIO V	IND. H	IND. V	ILL. H	ILL. V	MICH H	MICH V	WIS. H	WIS. V	MINN H	MINN V	IOWA H	IOWA V	MO. H	MO. V	N.D. H	N.D. V	S.D. H	S.D. V	NEB. H	NEB. V	KAN. H	KAN. V	DEL. H	DEL. V	MD. H	MD. V	D.C. H	D.C. V	VA. H	VA. V	W.VA H	W.VA V
SD	H-B													1				2		2		1		2		1		1		9	2	4	1	1		1	1	6580		3	1	1											
	H-P							3						3		1		2		3		6	1	7	1	4		1		10	3	9	2	2	1	1	3	535		3	2	2	1			1		2	1				
	H-J							2						3		1		2		3		4	1	6	1	4	1	4	1	5	2	4	1	1	1	2	4	1425		2	2	2	1	1		2			1	1			
	B-P							3						3		1		2		1		7	1	7		4		6	1	7	1	11	2	2	1	1	2	638		3	2	3	1			1				1			
	B-J							2						2		1		2		4		4	1	5		4		5	1	5	1	3	1	3	1	2	4	1523		2	1	2	1			3		1	1	1			
	P-J													3				3		4		4		5		1		6		5		16	1	3	3	1	1	21	6	6	1	4						3					
NEB	H-B							1						1				2		2	1	1	1	2	1	4	1	4	2	2	1	4	2	1	1			7281		2	2							1					
	H-P							2				1		4		1		2		4	1	2	1	4	1	2	1	3	2	3	1	7	3	3	2		1	2950		2	3			1	1	1	1	1			
	H-J							2	1			1	1	3		1		2	1	4	1	2	1	4	1	2	1	3	2	3	2	4	4	3	2	1	3	2036		3	4	1	1	2	1	1	1	1	1		
	B-P							1				1		4				2		2	1	3	1	5	1	4	1	4	1	2	1	6	3	2	1			7		3453		2	2			1	1	1	1				
	B-J							1						3		1		2		4	1	2	1	4	1	3	1	3	2	3	1	4	3	3	2		2	2437		3	3	1	1	2	1	1	1				
	P-J					1		1				1		3				1		3	1	2	1	3	1	2		3	1	5	3	3	3	5	3	1	3	3739		4	3	1	1	2	1	1	1				
KAN	H-B							1														1	1	2	1					1	1	1	1	3	2					1	1	7879											
	H-P			1				3	1			1	1	4	1	1	1	2	1	2	1	5	2	7	2	5	2	3	2	2	1	5	3	4	3		1			2	4	2134				1	1	1	1		
	H-J	1		1		1		2	1	1		1	1	3	1	1	1	2	1	3	1	3	2	6	2	3	1	3	2	1	1	3	3	4	4		3		1	2	5	2130		1		1	1	2	1	1	1		1
	B-P			1				3	1			1	1	3		1		2	1	2	1	5	2	7	2	5	2	3	2	2	1	5	3	4	3		1		1	2	4	2438				1	1	1	1		
	B-J	1		1		1		2	1			1	1	3		1	1	2		3	1	3	2	6	2	3	1	3	2	1	1	3	4	5	4	1	4		1	5	2	2332		1		1	1	1	1	1	1		1
	P-J	1		1		1		2						3		2	1	2		4	1	3	1	4	1	3	1	2	1	1	1	1	1	3	3		1		1	2	3	2420		1	1	2	1	1	1	1	1		
DEL	H-B							8				3		7		2		17	1	5		2		2						1														4366		2							
	H-P					1	1	11				5		8		6	1	16	1	5		5		7		3		3																7	7	2		2					
	H-J							7				2		7		4		9		4		3		2		3		1		2						2				1	2			19	5	4		3		2			
	B-P					1	2	8		1		3		7		7		13		5		6		8		2		3		4										1	2	1		10	6	3		2					
	B-J	1						6				3		9		5		8		3		3		1		2		2						3						2		25	4	6		3					
	P-J					1		5				2		7		13	1	19	1	2		1		1		1		2		1				1								23	6	5		1		2		1	1
MD	H-B			1	1	1		4	1			1	1	5		1	1	8	2	2	1	1	1	1	1	1	1			1	1	1		1								1	5	5750		4	6	4	3	1	2
	H-P							7	1	1	2	2	1	9	1	3	2	9	2	2	1	2	1	4	1	2	1	1	1	1	1			1								1	6	2617		7	5	2	3		1
	H-J	1		2		2		5	1		1	2	1	8	1	5	1	8	2	3	1	2	1	3	1	2	1	1	1	1	1	1									1	2	2311		6	3	3	3		1
	B-P	4						5	1		1	1	1	10	1	2	1	8	2	3	1	3	1	4	1	3	1	2	1	1		1		1								1	5	2922		9	7	1	2		1
	B-J	1	2			3		4	1		1	1	1	9	1	3	1	7	2	3	1	2	1	3	1	2	1	2	1	1	1			1	1							1	2	2514		7	4	2	2		1
	P-J	2	1	3		2		3	1	1	2	2	1	5	1	4	2	5	2	2	1	2	1	2	1	2	1	1	1	1	1			1	1							1	2	3425		11	8	3	3		2
DC	H-B							9	1	1	1	2	1	8		2	1	6	1	4		1		3		2		1		1				1									1	17	8	3329		3	1	1	1		
	H-P							12	1	1	1	3	1	11	1	4	1	4	1	2		3	1	5		4	1	2		1				1				1						12	4	16	6	3	2				
	H-J			1	1	1	2	7	1	1	1	2	1	9	1	3	1	5	1	3		2	1	4		2		1		1				1										13	3	17	5	3	1		1
	B-P							5	1	1	1	2	1	11	1	3	1	6	1	2		3	1	3		1		1		1				1										6	2	3917		1	1				
	B-J	1		1		1		4	1	1	1	2	1	14	1	3	1	6	1	2		2	1	2		1		1		1				1								1	1	12	4	22	7	3	1	1	1
	P-J	1		2		4		3	1		1	1	1	6	1	2	1	5	2	3	1	1	1	2	1	1	1	2	2	1	1	1	1	1	1							1	1711		3424		4	5				
VA	H-B			1				3	1			1	1	3		2	1	2		2	1	1	1	1	1	1	1																	2	2		3	5	5965		1	2
	H-P						1	5	1			2	1	8	1	3	2	5	1	2	1	3	1	4	1	2	1	3	1	1	1	2	1	1	1	1							2	3	4	3	3	3	1831			2
	H-J	1		2		1		3	1			1	1	6	1	3	1	4	1	3		1	1	3	1	2	1	2	1	1	1	1	1	1	1							4	2	6	3	2120		1	3
	B-P							5	1			1	1	9	1	3	1	7	2	2	1	3	1	4	1	3	1	2	1	1		2	1	1		1							2	3	2	3	2	2334		1	5
	B-J			2		2		2	1			1	1	5	1	3	1	5	1	4	1	1	1	3	1	1		1		1		1	1	1								2	2	4	2	4	2	2621		1	4
	P-J			1		1		2				1	1	5		3	1	4	1	4	1	1		2		1		1		1		1		1								2	2	3	1	3	1	2916		2	3
WVA	H-B							2				1		1		1		3		8	1	1		2		1																		1	1					4	2	6477	
	H-P							3				1		5		1	2	9	1	11	2	6	1	6	1	5	1	4	1	1		2	1	1		1								3	1			2	1	3	3	1155	
	H-J					1		2				1		6		2		5	1	8	1	3	1	3	1	1		1		1		1	1	2	1		1							2	2	6	2	3	1	5	3	1424	
	B-P							3				1		7		1		10	1	12	2	6	1	6	1	3		4	1	1		3	1	1								1	3	3	1	5	1	3	2	1353	
	B-J							2				1		7		3		5	1	8	1	4	1	3		3		1		1		1	1	2	1							2	2	5	1	2	1	5	2	1724	
	P-J		1					1						5		2		9		6		1		1		1		2				2		1		1		1	2			2		4		2		5	1	3111	
NC	H-B							1						1				3		1		1		1		1		2																1	1	2	2				
	H-P	4						3	1	1	2	1	1	6	1	2	1	2	1	2	1	4	1	4	1	3	1	2	1	1				1										2	1	3	5				
	H-J	1		1				2	1		1	1	1	4	1	1		2		2	1	2	1	2	1	1		1	1	1		1	1		1							1	1	3	2	2	1	6	6	1	2
	B-P	4			2			4	1	1	2	2	2	7	1	3	2	3	1	2	1	3	1	4	1	3	1	2	1	1		1		1										2	2	2	2	1	1	3	6		1
	B-J	2		1		1		3	1		2	1	1	5	1	2	1	3	1	3	1	1	1	3	1	1	1	1	1	1		1		1										3	2	2	1	1	1	6	7	1	2
	P-J	3		1		2		2	1		2	1	1	4	1	1	1	3	1	3	2	2	1	3	1	1	1	1	1	1		2		2										2	2	2	1	1	1	6	9	1	3

FIGURE D-1—Continued

ST NU		N.C. H	N.C. V	S.C. H	S.C. V	GA. H	GA. V	FLA. H	FLA. V	KY. H	KY. V	TENN H	TENN V	ALA. H	ALA. V	MISS H	MISS V	LA. H	LA. V	ARK. H	ARK. V	CKLA H	CKLA V	TEX. H	TEX. V	N.M. H	N.M. V	ARIZ H	ARIZ V	UTAH H	UTAH V	NEV. H	NEV. V	MONT H	MONT V	IDA. H	IDA. V	WYO. H	WYO. V	COL. H	COL. V	WASH H	WASH V	ORE. H	ORE. V	CAL. H	CAL. V	AKA. H	AKA. V	HAW. H	HAW. V	ROW TOT.
S D	H-B																																		1															637
	H-P							1		1	1											2	1	2												1	2	2	1					2						637
	H-J	1				1		1		1		1		2	1			1				1		2		1	1	1	1			1		2	4	1	1	2	5	7	2	3	1	1	1	8				9		1		1	508
	B-P	1						1		1	1	1						1				4	1	2				1	1	1	1			1	2			3	5	6	1					5						515
	B-J	1				1				1		1		2	1			1						2		1	1	1	1			1	1	3	4	1	1	1	2	3	1			2	1	6		1				416
	P-J	1				1		1				1		3						1		1										1	1	1				1		1				1		1	1		1			80
N E B	H-B																																																		
	H-P	1	1		1		1	1												1		2	1	1			2	1	3					2		4	1	8	3	3	1	2	1	2	3	1					1460
	H-J	1	1		1	1	1	1		1	2	1	1					1	1			1	1	3	1	1	2	2	3	1	1			2				6	5	4	2	2	2	2	2	9	1			3	1	1460
	B-P	1	1		1		1	1			1											2	1	1	2			1	2	1	1					4		1	8	7	4	1	1	1	1	5	1			3		1183
	B-J	1	1		1	1	1			1	1	1	1		1			1				1	1	4	1	1	2	1	1	1	1			3		2		2	5	3	2	2	1	1	1	9	1			1		1299
	P-J									1	1	1		1	1	1				1		1	1	2		1	2	1	1					2		1		1	5	3	2	2	1	1	1	4		2		1		1035
K A N	H-B																																																		696
	H-P	1	1					1	1		1	1	1				1	1	1	1	6	3	7	1	2	4		1	2						3					2	3					2	1					1958
	H-J	1	1		1		1	1	1	1	1	1	1	1	1		1	1	2	1	4	4	5	3	2	1	3	1	2	1	1				3		4		1	9	6	3	1	2	1	2	7	1					1958
	B-P	1	1				1	1	1		1	1	1					1	1	1	6	6	7	3	2	1	3	1	2		1				3		2		1	8	3	4	2	2	1	2	8	1	5		1		1587
	B-J	1	1		1		1	1	1	1	1	1	1	1	2			1	1	1	3	4	6	5	2	1	1	1	2		1				1		3		1	9	5	3	2	2	1	2	7	1					1929
	P-J	1		1	1	1		1	1	1	1	1	1	1	1	1		2	2	1	3	3	2	6	2	1	1	1	1		1	1	3		2	1	2		1	7	2	2	1	1	1	1	5		4		1	1551
D E L A	H-B	1																																																930
	H-P	4						1				1						1						1																1								6				1	242
	H-J	3						2		1		2		1				1				1		2								1	1			1				1			1			9					242
	B-P	4				1		1										1						1																1										1	191
	B-J	2						1														1		1								1	1			1				1		1		5			1	1	157
	P-J											1						1				2		1																1		2		8					118
M D	H-B	2	1			1	1	1	1			1	1																															3					208
	H-P	3	1					2	1		1	1	1					1	1					1	2		1													1	1					4	1	6		1	1312
	H-J	2	1	1	1	1	1	1	1	1	1	2	1					1	1					2	1		1		1											1	1					7	1	1		1	1312
	B-P	2	1					2				1	1									1	1	2	1		1	1	1	1										1	1					5	1				1091
	B-J	2	1	1	1	1	1	2			1	1	1	1	1			1	1	1	1	1	1	2	1	1	1		1		1									1	1					7	1				1477
	P-J	1	1	1	2	1	1	2	2		1	1	1		1			1	1					1	1	1	1					1		3		1		1			1	1				5	1			2	1641
D C	H-B	1		1	1	1		1																1																											738
	H-P	3	1					2	1			1												2																						1	7		6			738
	H-J	2	1	1	1	1		1		1		1						1				1		2																1		1		1	1	10	1	1			596
	B-P	2	1					1	1			1												1				1	1											1						5					821
	B-J	2	1			1	1	1	1	1	1			1	1			1	1	1				2																1	1			1		6	1				663
	P-J	1	1	1		1	1	1	1	1	1							1	1	1				1								1		1		1		1			1			4	1	1		1	1524
V A	H-B	8	7	1	2	1	1	1	1	1	1	2	2		1																																				1541
	H-P	12	7	1	5	2	3	3	2	1	2	2	2					1	1			1	1	1			1							1																1541
	H-J	7	5	2	5	3	3	2	2	2	3	3	2	2	3		1	2	2			1		2	1		1							1											1	1				1259
	B-P	11	6	1	4	2	3	3	2	1	2	2	2					1	2			2	1		1	1	1							1																
	B-J	6	4	3	5	4	3	2	2	1	2	4	3	1	2	1	1	2	2	1	1	2	1		1	1	1							1																1388
	P-J	4	2	4	5	3	2	3	1	2	2	3	2	2	2	1	1	2	1		1	3	1	3	1	1	1							1				1											1112
W V A	H-B	2	1			1		4	3																																								752
	H-P	5	2		1	1	1	3	1	2	3	1	1	1	1		1	1						2			1							1				1												853
	H-J	3	1	1	1	1	1	4	2	2	2	3	1	1	1	1	1	1		1	1			2			1		1					1	1				1											853
	B-P	4	1		1	2	1	2	1	2	2	3	1	1	1			1		1		1		1			1	1						1				1											667
	B-J	3	1	1	1	1	1	4	2	2	1	3	1	1	1	1	1	1		1	1			2		1	1							1															708
	P-J	4		1		3		3		1		1		1				1		1				1										1															552
N C	H-B	8064		3	6	1	2	1	1	2	2	2	2	1	1																																			137
	H-P	3621		1	2	3	5	4	3	1	4	4	3	1	3			1	1					1	1																									1470
	H-J	3223		5	1	3	3	4	3	2	3	5	4	2	3			1	1		1			3	1	1	1		1					1	1		4		1		1	1		1	1	4	1			1	1470
	B-P	3526		1	1	5	2	4	4	1	2	4	5	1	3		1	1	1					2	1									1		2				1	1		1	1	4	1			1	1200
	B-J	3027		4	1	2	4	5	4	2	3	4	5	1	3	1	2	2	2					1	1									1						1	1		1	1	4	1			1	1846
	P-J	3035		5	1	4	7	3	4	1	3	4	5	1	4	1	4	3	4		1			3	2		1		1					1		1				1	1		1	1	3	1			2	1505
																										1	3		1					1		1				1	1		1	1	4	1	1		2	1976

FIGURE D-1—Continued

ST NO		ME. H	ME. V	N.H. H	N.H. V	VT. H	VT. V	MASS H	MASS V	R.I. H	R.I. V	CONN H	CONN V	N.Y. H	N.Y. V	N.J. H	N.J. V	PA. H	PA. V	OHIO H	OHIO V	IND. H	IND. V	ILL. H	ILL. V	MICH H	MICH V	WIS. H	WIS. V	MINN H	MINN V	IOWA H	IOWA V	MO. H	MO. V	N.D. H	N.D. V	S.D. H	S.D. V	NEB. H	NEB. V	KAN. H	KAN. V	DEL. H	DEL. V	MD. H	MD. V	D.C. H	D.C. V	VA. H	VA. V	W.VA H	W.VA V
SC	H-B							1				1		1				1		3		1		1				2											1					1		1			
	H-P							3				3	1	7		1		3		2		4	1	3		3						1										2	1	1		5	4		
	H-J							2				1		3		2		2		2		1		2		1						1								1				5	2		1
	B-P							2				2		6		1		3		3		4	1	2				1				1												2	1		6	4		1
	B-J							1				1		3		1		3		2		1		2		2						1								1				3	2		1
	P-J							3		1		1				1		2		1		1		3		1						1		1						1				1			1
GA	H-B				1			1				1		2						1		1		1				2				2		1										1					
	H-P							5	1			2	1	7	1	1	1	3	1	2	1	2	1	4	1	2	1	2	1	1		2	1									1	1	1	1	2	2		
	H-J				2			3	1			1	1	3		2		3	1	2	1	1		2		2	1	1						1	1							1	1	2	1	3	2		1
	B-P							5	1			1	1	6	1	1		2	1	3	1	2	1	4	1	2	1	3	1	1	1	2	1									1	2	1	2				
	B-J				1			3	1			1	1	3		1	1	2	1	3	1	2	1	3	1	2	1	1	1													1	2	1	2				
	P-J							2				1		3		1		2		1		1		2		1						1		1								1	1	1	1	2	2	1	1
FLA	H-B							3	1			2		2		1		1		2		1		2		1		2	1			2	1											1	2				
	H-P							5	1			2	1	6	1	1	1	3	1	3	1	2	1	4	1	3	1	2	1			1	1									1	1	2	1	1	2		
	H-J	1		1		2		3	1		1	1	1	6	1	2	1	3	1	3	1	2	1	2	1	1		2	1			1	1									1	1	2	1	2	2		1
	B-P				2			3				1	1	7	1	1		3	1	3	1	3	1	4	1	3	1	2	1			1												1	2		1		
	B-J	1	2				1	2		1		1	1	5	1	2	1	3	1	3	1	2	1	2	1	1		1				1	1		1							1	1	2	2	1	2		1
	P-J		2		1			1				1	1	3	1	2	1	2	1	3	1	1	1	2	1	1		1				2	2		1							1	1	2	2	1	2		1
KY	H-B							2						1				1		5	1	3	1	1		1		1				2	1											1	2				
	H-P							3	1			1		6	1	1		2		9	2	11	3	7	1	3	1	2	1			2	1											1	2				
	H-J				1			3	1					4		2		3	1	7	2	1	1	5	1	2	1	1	1			2	1									1	1	2	2	1	1		
	B-P							2				1		5		1		2		7	2	12	3	7	1	4	1	2	1			2	1									1	1	1	1	2	2		2
	B-J	1				1		2	1					3		1		3	1	7	2	4	2	4	1	2	1	1	1			2	1									1	1	2	2	1	2	1	2
	P-J							1						3				3		6	1	2		3		1						2	1									1	1	2	2	4	1	2	2
TEN	H-B							3	1			1	1	1				1		1		1		2		1						1	1											2	2		1		
	H-P				2		1	4	1		1	2	1	4		1	1	2		3	1	2	1	5	1	4	1	2	1	1	1	1	1											1	1			2	3		1
	H-J		1				1	2	1		1	1		2		2	1	2		3	1	2	1	3	1	2	1	1				1	1									1	1	1	1	2	3	1	2
	B-P		1		2		1	4	1		1	2	1	5	1	1	1	2	2	3	1	4	1	5	1	3	1	2	1	1	1	2	1		1								1	2	1	2	2	3		
	B-J		1					1						3		1	1	2	2	3	1	2	1	3	1	2	1	1	1			2	1									1	1	1	1	2	3	1	3
	P-J							1				1	1	2		2	1	2	1	2	1	2	1	2	1	1		1				2	1									1	1	2	2	1	3	1	4
ALA	H-B							1						1				1		1		1		1				2				1												1	1				
	H-P							3		1		1	1	7	1			2		3	1	3	1	4	1	3	1	2	1	1		2	1									1		1	1	1	2		
	H-J							2				1	1	3		1		1		2		1		2		1		1				1										1	1	2	2		1
	B-P							2		1				8	1	1		2		3	1	3	1	5	1	3		2	1	1		2	1										1	2	1	2	2		1
	B-J				1			2				1		3		1		1		2		1		2		1		1	1			1										1		2	1	2	2		
	P-J				1			1								1		1		1		1		1		1						1										1		1	1	3	1		1
MIS	H-B													1										1																									
	H-P							3				1		5				1		2		5	1	5	1	2		1		1		2		2	1									1		2	1		
	H-J													2		1		2		1		1		3		1		1				1		2	1							1		1		2	1		
	B-P				1			3				1		4				1		2		5	1	4		1		1				2	1	1	1							1	1			2	1		1
	B-J													1		1		1		1		1		2				1				1		2	1											2	1		
	P-J													1																																			
LA	H-B							1						1										1																									
	H-P				2			3				1		4				1		2	1	4	1	4	1	2	1	1		1		3	1									1	1			1	1		
	H-J				1			1				1		3		1		2		2		2	1	3	1	1		1	1			2	1		1							1	1	1	1	2	1		1
	B-P				2			2			1	1		3		1		2		2		4	1	4	1	3	1	1		1		3	1	2	1			1				1	2	1	1	1	1		1
	B-J					1		1						3		1		1		1		1		3	1	1		1	1			1	1									1	1	1	1	2	1		1
	P-J					1						1		2				2		1		1		2				1	1			2	1									1	1	1	1	2	1		1
ARK	H-B							1				1		1										1				2				2	1											1					
	H-P							2				1		3		1		1		2		4	1	7	1	2		2	1	1		4	2									1		2	1			1	1		
	H-J						1	1			1			2		1		1		2		2	1	3	1	2		1		1		6	2		1							1	1	2	1		1		1
	B-P							1						2		1		1		2		5	1	5	1	2		2		1		4	2									1	1	2	1				
	B-J							1						1		1		1		1		2	1	2		1		1				6	2									1	1	2	1				
	P-J							1						1						1		1		1		1						9	2									2	1	7	2				1

FIGURE D-1—Continued

ST NO		N.C. H	N.C. V	S.C. H	S.C. V	GA. H	GA. V	FLA. H	FLA. V	KY. H	KY. V	TENN H	TENN V	ALA. H	ALA. V	MISS H	MISS V	LA. H	LA. V	ARK. H	ARK. V	OKLA H	OKLA V	TEX. H	TEX. V	N.M. H	N.M. V	ARIZ H	ARIZ V	UTAH H	UTAH V	NEV. H	NEV. V	MONT H	MONT V	IDA. H	IDA. V	WYO. H	WYO. V	COL. H	COL. V	WASH H	WASH V	ORE. H	ORE. V	CAL. H	CAL. V	AKA. H	AKA. V	HAW. H	HAW. V	ROW TOT.
SC	H-B	9	3	7170		4	2			1		3	1	1	2		1	2	1			1		1													1													679
	H-P	18	5	937		5	4	6	2	1	2	8	4	2	2		2	3	1			1		2																				6					679
	H-J	12	4	2423		6	3	2	1	2	1	5	2	3	2	2	2	3	1			1		5	1									1				1											527
	B-P	19	5	1143		6	5	7	3	1	2	7	3	2	3	1	1	2	1			1		1		1																							690
	B-J	12	4	2425		8	4	3	1	1	2	5	2	3	2	2	2	2	1	1	1	1		4	1	1														1									556
	P-J	10	1	3510		6	1	3		2		6	1	3	1	4	1	1				1		5								1	1														147
GA	H-B	5	3	2	4	7170		3	3		1	3	2	4	4									1											1	2												1258
	H-P	9	4	1	7	2436		9	6	1	2	5	4	3	6	1	4	2	2			1	1	4	1									1				1									1	1258
	H-J	6	4	4	8	3027		5	4	1	1	6	4	4	5	1	2	2	2	1				4	1			1										1	1	1	1							1054
	B-P	8	4	1	4	2843		8	5	1	3	5	4	2	5	1	5	2	2			1	1	2	1																							1286
	B-J	5	3	3	6	3128		6	4	1	1	6	5	4	5	2	4	2	2	1				4	1	1	1	1																		1	1062
	P-J	5	2	4	5	3824		4	2	2	2	8	4	4	4	2	4	2	1	1				5	1			1						1		1											744
FLA	H-B	4	3	1	3	6	7	6069		1	1	3	3	3	4			1	1					1								1										2		4			1464
	H-P	7	4		2	4	6	2921		1	1	3	3	1	3			3	3	1				3	1		1	1	1					2						1		1	1			5	1		1	1464
	H-J	4	3	2	4	6	6	2318		1	1	3	2	3	5	2	4	3	3	1	1	1	1	5	1	1	2	1				1								1	1	1	1			6	1		1	1176
	B-P	6	3		1	2	3	3825		1	2	2	2	1	3		2	3	3		1			3	1		1							1	2				1	1					3		1	1276
	B-J	4	2	2	3	6	5	3120		1	2	2	1	3	4	2	4	3	3	1	1	1	1	4	1	1	1												1	1	1				5			996
	P-J	5	5	3	7	7	9	3334		2	3	4	4	4	7	3	8	2	3	1	2	1	1	3	1	1	2	1	1			1								1	1					5	1	1	1548
KY	H-B	1	1		1	1	1	1	1	7174		5	4											1	2		1																						1251
	H-P	4	2		1	2	2	4	2	1846		6	5	1	1	1	2	2	2	1	1	1	1	2	1		1													1	1					3		6	1251
	H-J	3	2	1	2	2	2	2	2	2329		7	5	1	2	1	1	3	3	1	1	1	1	3	1	1	1	1	1					1						2	1	1				4		1	1017
	B-P	5	2		1	2	2	5	3	2048		6	4	1	2	1	3	1	1			1	1	2	1		1	1	1					1						1	1					2			1197
	B-J	4	2	1	3	2	2	3	2	2631		6	4	1	2	1	2	1	1	1	1	1	1	3	1	1	1	1	1					1						2	1			1	1	2		1	975
	P-J	3	1	2	1	2	1	2	1	3720		5	2	1	1			1		1	2	1		3		1						1								1		1				1		1	430
TEN	H-B	2	2	1	1	3	3	1	1	2	3	6962		1	1	1	2	1	1	1	1			2	1																							1440
	H-P	5	3		1	4	6	4	3	1	3	2927		2	5	2	10	2	2	1	2	1		4	2		2		1						2					1	1				4	1		1440
	H-J	6	4	2	4	5	5	4	3	2	3	2823		3	5	1	3	3	3	1	1	1	1	5	2	1	1	1	1			1								1	1					5	1	1	1190
	B-P	5	3		4	4	7	5	4	2	5	2930		2	5	210		2	3	1	2			4	2		1													1	1					3			1594
	B-J	6	5	2	4	5	6	4	4	2	4	2926		3	5	1	3	4	4		1	1	1	5	2	1	1							1										4	1		1313
	P-J	6	4	2	4	4	4	4	3	3	5	3429		4	6	1	3	2	2	1	4	1	1	4	1	1	1		1					1										3		1	1223
ALA	H-B	2	1	1	1	4	4	1	1	1	1	6	4	7373		1	2	2	2					1																							1156
	H-P	6	3	1	4	4	5	7	4	1	1	7	5	2446		1	3	4	4			1	1	4	1															1	1					3			1156
	H-J	5	2	2	3	8	6	6	4	1	1	6	4	2731		3	5	5	4	1				5	1															1	1					3			902
	B-P	6	3	1	5	3	4	5	3		1	6	5	2751		1	4	4	4			1	1	3	1																							1155
	B-J	4	2	3	4	8	6	6	3	1	1	5	3	2934		3	6	5	4	1	1	1		4	1	1	1							1										3			919
	P-J	3	1	4	3	10	4	3	1	1	1	7	2	4125		7	7	6	3	2	2	1		3																1							493
MIS	H-B					2	1	1	1			5	3	3	2	7286		7	4					2																							775
	H-P	4	1		2	3	3	5	2		1	6	3	5	6	1539		10	7	1	2	2	1	8	2	1	1	1	1											1	1					1		1	775
	H-J	5	2	1		5	3	6	2	1	1	6	2	4	3	2635		12	6	1	2	1	1	8	1	1			1											2	1	1				3			644
SS	B-P	4	1		2	3	2	5	2		1	7	3	5	5	2042		9	5	1	2	3	1	8	1	1	1													1					2			648
	B-J	3	1			4	2	5	2	1	1	6	2	4	3	3134		11	5	2	2	1	1	9	1	1																		3			538
	P-J	3		2	1	5	1	4	1	2	1	8	1	3	1	3821		14	3	3	2			6								1															263
LA	H-B					1	1					1	1	1	1		1	8277						4	1	1	2																					1203
	H-P	2	1			1	1	3	2		1	2	2	1	3	2	8	3232		3	8	2	2	10	3	2	3		1											2	1					4			1203
	H-J	2	1	1	1	2	2	2	1	1	1	2	1	2	3	2	5	3830		2	4	2	2	10	3	2	2	1	1			1								1		1				5		2	966
	B-P	2	1		1	1	1	4	3		1	3	3	2	4	2	8	3335		310		2	2	9	3	1	3													1	1					4			1288
	B-J	1	1	1	2	2	2	2	2	1	1	2	2	2	3	3	6	3832		3	7	2	2	9	2	1	2					1								1	1					5			1042
	P-J	1	1	2	4	3	2	2	1	2	2	3	2	2	3	3	7	3729		3	6	2	2	9	2			1	1											1	1	1	1			4		1	956
ARK	H-B					1	1					3	2	1	1	1	1	4	3	6882		5	3	7	2																							967
	H-P	3	1		1	2	2	2	1		1	5	3	1	1	2	5	6	5	1843		6	4	11	3	1	2	1	1											1	1					4			967
	H-J	2	1	1	2	3	2	1	1	2	2	5	2	3	3	3	4	5	3	2139		4	3	12	2	1	1	1	1			1		1		1				1		1				6		1	763
	B-P	3	1		1	1	1	2	1	1	1	5	2	1	1	2	6	6	4	2548		6	3	10	2		1	1	1					1			1			2	1					2		1	800
	B-J	3	1		1	2	1	1		2	1	5	2	3	3	3	4	5	2	2640		4	2	11	2	2	1	1	1			1				1				1						4			635
	P-J	1		1	1	1				1	1	3	1	1	1	3	2	10	3	2521		6	2	14	1	2	1	1	1			1				1	2			1	1					2			344

FIGURE D-1—Continued

ST NO		ME. H	ME. V	N.H. H	N.H. V	VT. H	VT. V	MASS H	MASS V	R.I. H	R.I. V	CONN H	CONN V	N.Y. H	N.Y. V	N.J. H	N.J. V	PA. H	PA. V	OHIO H	OHIO V	IND. H	IND. V	ILL. H	ILL. V	MICH H	MICH V	WIS. H	WIS. V	MINN H	MINN V	IOWA H	IOWA V	MO. H	MO. V	N.D. H	N.D. V	S.D. H	S.D. V	NEB. H	NEB. V	KAN. H	KAN. V	DEL. H	DEL. V	MD. H	MD. V	D.C. H	D.C. V	VA. H	VA. V	W.VA H	W.VA V
OKLA	H-B							1			1	1	1	3			1	1	1	1	1	1	1	5	1	3	1	2	1	1	1	3	2	1	1					2	2				1						
	H-P							3	1			1	1	3				2	1	2	1	1	1	5	1	2	1	2	1	1	1	3	2	3	2					2	4			2							
	H-J	1				1		2			1	1	1	3		1		1		2	1	1	1	4	1	2	1	2	1	1	1	4	3	4	3	1	3	1	3	2	4	5		1	1	1	1	1	1		1
	B-P							1				1		2				1		2	1	3	1	5	1	3	1	3	1	1	1	3	2	2	2	1	3		2	2	3		1		1	1					
	B-J					1		1			1			3		1		1		2	1	1	1	3	1	1	1	1	1	1	1	1	1	4	3					1	2			1	1	1	1				
	P-J										1			1				1		1		1	1	3	1								4	3	1	4	1	2	1	2	6	7			1	1	1	1			1
TEXAS	H-B							1	1				1	1			1	1		1		1	1	1	1								1	1							1										
	H-P		1					3	2		2	1	2	3	1	1	2	2	1	2	2	2	2	4	2	2	2	2	2	1	2	3	1	3	4		1	2			1	4		2	1	2	1	1			
	H-J		1		1			2	1		1	1	1	3	1	1	1	2	1	2	1	1	2	2	2			1	2		1	3		2	4		2		1		1	4		1	2	1	2		1	1	2
	B-P				1			3	2		2	1	2	3	1	1	2	2	1	2	2	2	2	4	2	2	2	2	2	1	2	3	1	3	4		1	2			1	3		2	1	2	1	1			
	B-J	1						2	1		1	1	1	3	1	1	1	2	1	2	1	2	2	2	2	2	1	1	1	1	2	4	2	2	4		1	3			1	4		1	1	2	1	1			
	P-J	1						1			2		1	1		1	1	1	1	1	1	1	2	2	1			1	1				2	3	4		1	3			2	3		1	2	1	1	1	1	1	2	1
NM	H-B							1				1		4		1		1		2		2		1	4	1	3	1	2	1		2		1	2						1					1	2					
	H-P							4				1		2		2		2		2		2		4	2	2	2	2	1			2		1	1						2	1				2	2		1		
	H-J							1				1		2		2		2		2		2		3	2			1	1			1		2	1						2	1				1	1				
	B-P							3				1		6		1		2		2		2		4	3	2	1	2	1	1		2		3	1					1	2					1	1				
	B-J													2		2		3		1		1		4	2	2	1	1	3			1		2	1					1	1			1						
	P-J					1	1	1						2		1		2		1		2		2		1	3							2						1	3	1	1		1	1	1				
ARIZ	H-B							2				1		2				1		2		1		3				2				1								1										
	H-P							5				2		5		2		2		2		3		6		3		2				3		1						1						1				
	H-J							3		1		1		6		3		2		2		1		1		1		2				1		1						1	1		1	1		1				
	B-P			1				3				1		5		1		2		3		3		4		4		2		1		3								1										
	B-J					1	1	1				1		5	2	2		2		3	2	1		1	3	4	1	2		1	1	1		2	1	1				1	2			1		1				
	P-J						1	1						2		2		2		2		2		3		1		2	1	1	1	2	1	2	1			1	1	3	1			1	2	1	1			
UTAH	H-B							1				1		5		1		2		2		3		4		3		3		2		2		1						1										
	H-P				1			4	1		1			4		1	1	1		2	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1						1					1	1				
	H-J	1				1		2			1	1		4		2	1	1		2		1	1	2		1		1	1	1	1	2	1	1	1		2		1		1	1	1	2	1				1
	B-P			1				3	1		1	1		5	1	1	1	2	1	2	1	4	1	5	1	4	1	3	2	2	1	2	1	1	1		1		2		1	1		1	1				
	B-J	1			1			2	1			1		4	1	2	1	1		2	1	1	1	3	1	1		1	1	2	1	1		2				1		1	1			1	1	2	1			
	P-J							1						3		2		1		2		1		3		1		1		2	1	1		1		1	3		1		1	1		1	1	2	1			1
NEV	H-B													2						2		1		1						2		1																		
	H-P							2						3		2		2		2		3		7		5				2		5		2												2				
	H-J							3						3		3		1		3				2		2				3				1								1				3		1		2	
	B-P							1						4						3		1		6		3		1		4		4		1												1				
	B-J													4		3				1										3		1														1		1		1	
	P-J													3						1								13																						
MONT	H-B							2						1						2		2		3		4		4	1	4	1	1		1						1		1								
	H-P							4				1		5		1		4		2		5		3		4		4	1	5	1	4	1	1		1	2			2	1					1				
	H-J						1	2						4		3		3		2		1		3		4		2		3	1	2	1	2	1	1	2		1		1					2		1		
	B-P							2				1		4				4		3		5		4		5		4		4	1	4	1	2		1	2			1						1				1
	B-J					1	1	1						3		1		2		1		1		4		4		2		3	1	2	1	1		1	1			1						1				1
	P-J	1		1				3						3				1		1		1		2		5		1		4		2		1	1	4	2			1						1		1		1
IDAHO	H-B							1				1		5		1		1		2		5	1	6	1	6	1	3	1	1		3	1	1						1										
	H-P							3						3		2		2		3		1		4		2		1		2	1	1	1	1							1					1				
	H-J							3				1		3		2		2		3		1		4		2		1		2	1	1	1	1							1					1				
	B-P			1				2				2		4		1		1		1		4		7		6		3		2		4		2		1				1						1				
	B-J					1		2				1		4		2		1		3		1		3		2		1		2		1		1		1	1			1						2				
	P-J							2						2						2				2		2		2						2				1	2										
WYO	H-B							2						3						1		1		3				4		1		1		1				1										
	H-P							3				2		4		2		2		3		4		5		2		2		2		4		1				2	1		1			1				
	H-J											3		3				3		3		1		3		1		2		1		1		1				2	1		1			3				
	B-P							1		1		2		3		3		2		2		2		5		3		4		2		3		1		1		3	1		1					1			
	B-J					1	1					1		2		1		3		3		1		4		3		1		1		1		2				3	1					1				
	P-J						1							3				1						3		1		2		2				2		1	6	5	1		4	1				1				

FIGURE D-1—Continued

ST NO		N.C. H	N.C. V	S.C. H	S.C. V	GA. H	GA. V	FLA. H	FLA. V	KY. H	KY. V	TENN H	TENN V	ALA. H	ALA. V	MISS H	MISS V	LA. H	LA. V	ARK. H	ARK. V	OKLA H	OKLA V	TEX. H	TEX. V	N.M. H	N.M. V	ARIZ H	ARIZ V	UTAH H	UTAH V	NEV. H	NEV. V	MONT H	MONT V	IDA. H	IDA. V	WYO. H	WYO. V	COL. H	COL. V	WASH H	WASH V	ORE. H	ORE. V	CAL. H	CAL. V	AKA. H	AKA. V	HAW. H	HAW. V	ROW TOT.
OKLA	H-B											1								1	2	7878		5	2	1												1	1					2			4		1	1809
	H-P	1	1		1			1	1		2	1	1		1		2	1	1	1	6	3741		7	3		3								2				3	2	1	1	1	1	6	1					1809
	H-J	1	1		1	1	1	1	1	1	2	1	1	1	2	1	2	3	3	2	6	2837		11	4	2	4	1	2		1		1				2			3	3	1	1	1	1	7	1			1	1435
	B-P	2	1		1		1	1	1	1	2	1	2		1		2	1	2	1	5	4145		7	4	1	3	1	2							4		2		3	3	1	1	1	1	5	1				1811
	B-J	1	1		1	1	1	1	1	1	2	1	1	1	2	1	2	3	3	2	7	3040		12	5	2	4	1	2		1		1						3	3	1	1	1	1	6	1			2	1445
	P-J	1	1		1	1	2	1	1	1	1	1	1	2	3	1	3	4	4	3	9	3541		13	5	2	3	1	1	1	1		1						2	2					2				1	1283
TEXAS	H-B					1		1				1	2		1		1	1	3		2	2	4	8585			5		1		1						1	2	1	2				2	1		4			4343
	H-P	1	3		5	2		1	2		1	1	4		2		4	3	9		7	410		4754		1	8		1		1					2		5	3	2		1	2	6	2				4343
	H-J	2	3		3	1	3	1	3	1	2	2	4	1	4	1	6	3	8	1	9	310		4542		2	8	1	5		1		3			3			5	2	4	1	2	1	2	7	2		6	2	3393
	B-P	2	3		4		1	1	3		2	2	5		2		3	310		1	7	4	9	5058		1	9	1	4		1		2			2			3	2	4	1	1		1	5	2				4376
	B-J	2	4		3	1	3	2	4	1	3	2	4	1	4	1	7	3	9	1	9	3	9	4644		2	8	1	4		1		1			3			3	1	3	1	2	1	2	6	2		5	2	3413
	P-J	2	3		3	1	2	1	3	1	2	2	3	1	4	1	7	4	8	110		3	9	5141		2	6	1	3		2		1			2			2	1	2	1	2	1	2	5	1		6	2	2896
NM	H-B									1										1		2		8	1	6156		1	1										6	1					8				1	378
	H-P	1		1				2		1		2								1		3	1	9	1	1415		4	2	2	1		13					1	2		8	1	2		3	1	13				378
	H-J					1		1		1		1		1		1		2		1	1	3	1	8	1	24	9	1	1	1		1	2	1	1	1	1	1	1	6	1	2		2	1	15		1			321
	B-P	1		1				2				1						1		4	1	1720		7	1	1720		5	3		13							1	2	9	2	2		2	1	11				413
	B-J							1		1				1				1		1	1	2610		8	1	2610		1	1	2	1	1	1	1	1	1	1	1	2	6	1	2		2	1	14		1			339
	P-J							1		1				1								1		8	1	4114				1	1	1	1	1	1	1	1	1	2	6	1	2		1		6			1	1	280
ARIZ	H-B			1																		3		1	1	5855		7	2																	15	1				449
	H-P	2																1				1		4	1	1911		3	1															3	1	22	1				449
	H-J	2				1		1		1								1				1		5		15	7	4	2			1	3											2	1	23	1			1	1	353
	B-P	2						1										1				1		3		2918		1	1																	17	1				476
	B-J	1						2	1	1								1				1		5		2412		1	1			1	3											1		20	1			1	1	373
	P-J							1		1								1				1		4	1	3024		1	1			3	1											2	1	13	1		2	1	1	584
UTAH	H-B																													1	9169																			1336
	H-P	1																				1		1		1		2	1	2	3650					2		1	3												1336
	H-J							1	1			1										1	1	2	1	2	3	2	2	2	3755	1	6	1	2	2	7		3	3	2	3	3	2	1	1	14	1	1	1	4	1039
	B-P	1	1							1								1	1			1	1	2	1	3362		1	3				1		5		2		3	2	4	3	4	5	13	2				1771
	B-J	1	1			1		1	1		1	1	1			1		1	1			2	1	2	4	3367		2	4			110	1	3	210	1	5		3	3	4	3	2	3	14	2	1	1	5	1404
	P-J	1						1				1						2	1			2		2		3735		1	1			1	6	1	2	410		3	3	1	4	2	1	1	12	1		1	3	665
NEV	H-B													1														2	1	17	1	4869								2				2		19					126
	H-P	1						1										1				2		1		2	1	3	1	10	1								3		5		6	1	29		1	1		126
	H-J			1		1		3										1				1				1		2		6	1	8	6	2	1	2	1			6		4		3		28				3	1	102
	B-P	1						1				1						2				3	1	3				6	1	113									3		3		9	1	31		211				89
	B-J				1			3										3		1		1		3		1		1		11	6					1		10		4		3		32		3	2	1		72
	P-J																	13		13										13	1	13					1	13						13						8
MONT	H-B																											2		1	6681		1	1		1		1		8	2	4	2	5				1	521
	H-P	1																1		1		1		1				2	1		1137		1	4	1	2		3	1	10	3	8	3	11	1			1	521
	H-J									1		1										1		1			3	1			1625		3	4		1		3	1	10	3	4	2	15	1		1		431
	B-P	2																				2						2	1		1438			2	1	2		3	1	9	2	8	2	9					421
	B-J	1								1		1		1						1		2	1	3	1			2			1924		2	3	1	2		2		9	2	4	1	13					350
	P-J	1			1		1															2		4		1		1			2714		3	1				1		9	1	1		10		1	1		141
IDAHO	H-B							1										1				1			1		1	1	1	3011		1		1	1	4473		1	2	1		8	3	3	2	5			1	664
	H-P	1																				1				1		3	2	10	7			1	4	330			2	4	1	10	4	9	4	13	1			1	664
	H-J	1						1				1						1				1	1	2		1	1	4	3	11	8	1	3			2	3	815		1	2	4	1	12	4	5	3	14	1	1	1	548
	B-P	1																1				1				2	1	7	3					1	2	430		1	2	4	1	11	2	10	3	13				1	399
	B-J	2						1								1				1		2	1			2	1	2	1	5	2	1	1			3	3	1214			1	4	1	11	2	5	2	15			1	1	327
	P-J											5										2		2												12	2					2		22	1	12		15					41
WYO	H-B																			1										10	2																				272
	H-P							1				1						1				2		1		1	1	2	1	4	1					1	1		5078	10	2	1	1	6							272
	H-J	2						2		1		1						1				2		5		1		1		4	1					1	1		910	10	1	4	1	5	1	14					272
	B-P							1				1						1						3				3	1	3	1					1	1		1215	6	1	1		4	1	16			1	1	230
	B-J	1						1				1		1								1		4		2						1	1			4	2		1813	8	1	3		7	1	10					175
	P-J				1			1				1										1		4		1						1	1			3	2		1814	8	1	1		6	1	13			1	1	142
																																1	1			3	2		2932	10	1	3		3	1	4					206

FIGURE D-1—Continued

ST NO		ME. H	ME. V	N.H. H	N.H. V	VT. H	VT. V	MASS H	MASS V	R.I. H	R.I. V	CONN H	CONN V	N.Y. H	N.Y. V	N.J. H	N.J. V	PA. H	PA. V	OHIO H	OHIO V	IND. H	IND. V	ILL. H	ILL. V	MICH H	MICH V	WIS. H	WIS. V	MINN H	MINN V	IOWA H	IOWA V	MO. H	MO. V	N.D. H	N.D. V	S.D. H	S.D. V	NEB. H	NEB. V	KAN. H	KAN. V	DEL. H	DEL. V	MD. H	MD. V	D.C. H	D.C. V	VA. H	VA. V	W.VA H	W.VA V
COLO	H-B			1	1			2			1	1	1	2		1				1		1		3							1	1	1	1					1	1											
	H-P						2	3	1		1	1		7	1	2	1	2		2		3	1	5	1	4	1	3	1	1		4	2	2	1		1			1	2	1	1			2	1	1	1				
	H-J	1		1		1		3	1			1	1	4		2	1	2		2		2	1	3	1	2	1	2	1	1	1	2	1	2	1	1		1	2	2	3	1	2	1	1	2	1	1	1		1
	B-P	4				2		3	1			1	1	6	1	1	1	2	1	2	1	4	1	5	1	4	1	2	1	1	1	4	2	1	1		1			1	2	3	1	2	2			1	1		
	B-J	1		1		1		2	1			1	1	4	1	1		2	1	2	1	2	1	4	1	3	1	2	1	2	2	2	2	2	1	1	3			2	3	2	1	2	1	1	1	1	1		1
	P-J	1		1		1		1						2		1		2	1	2	1	2	2	5	2	3	1	3	2	3	3	4	2	2	1	5	211			2	6	4	6	1	1	1	1	1	1		2
WASH	H-B			1				2	1			1	1	1				1						1						1													1								
	H-P							4	1			1	1	7	1	1	1	1		1		3	1	6	1	2	1	3	1	2	2	1	1	1	1		1			1	2	1	1			1	1	1	1		
	H-J	1		1	3			3	1	1		1	1	5	1	2	1	2	1	2	1	1	1	4	1	2	1	2	1	2	2	1	1	1	1			2		1	2	1	1	1	1	2	1	1	1		
	B-P							3	1	1		1	1	6	1	1	1	1		1		3	1	5	1	3	1	3	1	2	2	2	1	1	1	1				1	1					1	1	1	1		
	B-J	1		2		1		2	1	1		1	1	4	1	1	1	2	1	1	2	2	1	3	1	2	1	3	1	2	2	1	1	1	1			2		1	1	1	2	1	1	2	1	1	1		
	P-J	1		2		3		2	1	1		1	1	3		2	1	2		2	1	1	1	2	1	3	1	2	1	3	2	1	1	1	1			1		2	2	1	2	2	1	1	1	1	1		1
ORE	H-B							2						1										2						1																				
	H-P							4	1		1	1	1	6	1	1		2		1		3	1	4	1	3	1	3	1	2	1	2	1	1		1		1		1	1					1	1				
	H-J			1	2		1	3	1		1	1	1	4		1		2		2		2	1	3	1	2	1	2	1	1	1	1	1	1		1		1		1	1	1	1			1		2	1			1	
	B-P							4	1		1	1	1	7	1	1		2		1		3	1	5	1	2	1	4	1	1	1	2	1	1		1		1		1	1					1	1				
	B-J			1	2		1	3	1		1	2	1	4		2		3	1	2	1	1	1	4	1	2	1	2	1	1	1	1	1	1		1				1			1			2	1	1			1
	P-J				1		1	2			1	1	1	4		1		1		1		2	1	2		2	1	2	1	1	1	1	1	1		1			1	3	1	1	1	1	1	1	1	1	1		
CALIF	H-B			1				1	2				1	1			1			1		1	1	1	1				1	3			1	2		1			1		1				2		2				
	H-P	4		1		2		5	5			2	1	5	2	1	3	1	2	1	2	2	3	3	3	2	3	2	3	1	3	1	2	2	1			1		2			1	2	3	1	3		1		
	H-J	2		3		2		4	5			3	1	4	3	2	3	2	2	1	2	1	3	3	3	2	3	2	4	1	4	1	3	1	2			2		1	2	1	4	1	5	1	4	2	5		2		2
	B-P	4				2		5	5			3	1	5	3	1	3	1	2	1	2	2	3	3	3	2	3	2	3	1	3	1	3	1	2			2		1		2		1	3	1	3		1		
	B-J	2		3		2		4	5			3	1	4	3	2	3	2	2	2	3	1	3	4	3	2	3	2	5	1	3	1	3	1	2			1		3		1	5	1	4	2	5		2		1
	P-J	2		6		1		3	6			3	1	6	4	2	5	2	2	1	3	1	4	3	5	2	4	1	6	1	5	1	4	1	2			1		4		1	7	1	5	1	6	1	4		2
AKA	H-B							11						4																4																				
	H-P							4				4		4						4								4		4																				
	H-J											4		17		4				8				4								4									4					4					
	B-P							4										4										12				8																	
	B-J							5								5						5		5		5										5													
	P-J													7																7												10							
HAW	H-B							4						3		1		2		2		3		3		2		2				2								1									
	H-P							6				1		10				2		3		4		11		5		6		3		6		2						1		1				2					
	H-J	1						3				2		4		2		1		3		3		4		3		3		2		2		1						1			2			3		2			
	B-P							5				2		11				1		5		4		11		5		5		5		7		1						1		1				1					
	B-J	1						3				2		6		1		1		3		4		6		6		1		1								1			2			6		1				
	P-J							4						6		2		2						2						2										2						2					
TOTAL	H-B	583	751	368	6657	712	19621	4577	2305	7266	5779	3532	6634	4432	2723	2812	2550	2648	372	515	1299	1929	157	1477	821	1388	708
	H-P	27	113	41	7399	529	26621	13690	2526	6054	4367	5100	7825	5875	3799	2370	3205	2102	179	86	835	1217	250	2006	1896	912	172
	H-J	288	325	195	4591	407	1739	9512	3519	4877	3858	2317	4541	3421	2077	1583	1291	1745	217	278	657	1120	770	2246	2171	1355	392
TOTAL	B-P	27	113	41	7399	529	26621	13690	2526	6054	4367	5100	7825	5875	3799	2370	3205	2102	179	86	835	1217	250	2006	1896	912	172
	B-J	288	325	195	4591	407	1739	9512	3519	4877	3858	2317	4541	3421	2077	1583	1291	1745	217	278	657	1120	770	2246	2171	1355	392
	P-J	288	325	195	4591	407	1739	9512	3519	4877	3858	2317	4541	3421	2077	1583	1291	1745	217	278	657	1120	770	2246	2171	1355	392

FIGURE D-1—Continued

ST NO		N.C. H	N.C. V	S.C. H	S.C. V	GA. H	GA. V	FLA. H	FLA. V	KY. H	KY. V	TENN H	TENN V	ALA. H	ALA. V	MISS H	MISS V	LA. H	LA. V	ARK. H	ARK. V	OKLA H	OKLA V	TEX. H	TEX. V	N.M. H	N.M. V	ARIZ H	ARIZ V	UTAH H	UTAH V	NEV. H	NEV. V	MONT H	MONT V	IDA. H	IDA. V	WYO. H	WYO. V	COL. H	COL. V	WASH H	WASH V	ORE H	ORE V	CAL. H	CAL. V	AKA. H	AKA. V	HAW. H	HAW. V	RUN TOT.
COLO	H-B																					1	1	1	2			1			2		3		1		1	7256		1		1	1	5	1			1	1205
	H-P	1		1			1					1	1									1	1	2	1	1	3	2	3	1	1							1	5	2414		2	2	3	3	16	2					1205
	H-J	1	1			1	1	1		1	1	1		1	1					1		1	1	3	1	2	2	2	3	1	1	2		1	2	1	2	2	9	2013		3	2	3	3	17	2	4		1	2	978
	B-P	1	1	1		1	1	1	1			1	1	1		1		1	1			1	1	2	1	1	4	1	3	1	1		3					1	8	2719		3	2	3	3	13	2	6				1541
	B-J	1	1		1	1	1	1	1	1	1	1	1		1			1	1		2	1	2	3	1	3	4	2	3	1	2	1	6	1	3	1	3	213	2117		3	2	3	4	14	2	4		1	3	1252
	P-J	1	1				1	1	1	1	1	1	1		1			1	1	2		1	2	4	2	3	5	2	4	2	4	1	7	1	6	1	6	112	2731		3	3	2	3	8	1	5		1	3	1748
WASH	H-B																											1						1	3	1	5	1		7476		710		6	1					1779
	H-P			1				1	1							1								1	2		2	1	2	1	1				1		7	2	2	2727		912	17	3		6		4	1779
	H-J	1				1		1	1			1	1			1								2	1	1	3	1	3	1	1	5		1	4	1	7	1	2	2422		811	19	3		5		2	1459
	B-P	1						1	1		1					1								1	2		1	2	1	1				3		11		2	2	2	3231		912	14	2				9	1728
	B-J	1	1			1		1	1		1					1		1						2	1	1	3	1	2	1	2	5		1	4	2	8	1	2	2825		710	18	3		4	1	3	1409
	P-J	1	1					1	1			1	1					1				1		2	1	1	3	1	2	1	2	1	6	2	8	313		2		3	3	3128		6	9	16	2	110		2	1439
ORE	H-B																												1	2	1					1		1	2		1	1	6	4	7465		8	1	4			1145
	H-P	1		1				1														1		1				1	2	1	1		2			7	1	3	3	2	10	6	2220		19	2	11		3	1145
	H-J	1	1					1	1			1						1				1	1	2		1	1	1	2	1	1		1	1	3	1	4		2	2	1	9	5	1917		25	2	1	6	1	2	912
	B-P	1	1					1	1													1		1	2			1	2	1	1		2			5	1	3	3	2	10	7	2424		17	2	11		3	1306
	B-J	1	1					1				1						1				1	1	2		1	1	1	2	1	2		2	1	4	1	4		1	2	1	9	6	2122		23	2	5		1	2	1062
	P-J	1	1					1	1	1	1							1	1			1		2		1	1	1	2	3	4		3	2	7	2	7		2	2	1	10	7	3031		17	2	1		1	2	1056
CALIF	H-B								1												1				1		5		6	1	5	18		2		3		1		1	3	1	4	210		8576		12		7	6887
	H-P	1	2					1	2		1		1		1		1		1		1		1	1	2		8	1	10	1	8	6	3		9		4		2	5	313		314		5738		11		13	6887
	H-J	1	2		1		1	1	3		1	1	2		1		1		2		2		2	2	3	1	7	1	9	1	7	1	5		7		4		2	6	3	9	212		5431		12		112	5694
	B-P	1	2				1		2		1		1		1				2				1	1	2		8	1	10	1	6	5	0		4		13		4	2	6	3	14	214		5943		11		15	7654
	B-J		2		1		1		2		2	1	2		1		1		2		1		2	2	3	1	8	1	9	1	6	1	2		6		8		3	1	6	2	10	211		5535		11		11	6325
	P-J	1	3		2		2	1	4		2		3		2		1		2		3		1	2	4	1	11	1	13	1	13	1	7		9		11		4	2	9	2	12	215		5751		12		19	8833
AKA	H-B					4				4														4																	26		7		26		1515				27
	H-P					4						4																4												4		15		4		44				27
	H-J					4						4																													13		4		21		4	1		24
	B-P											4						4						4				4		8										8		4		4		23		1217			26
	B-J	5										5												5																5						24		19	5		21
	P-J																																							14						5710			14
HAW	H-B											1												1						2										2		3	1	13				4580		261
	H-P											1										1		1						2	1					2				3		3	1	15				622		261
	H-J	1										1		1				3						2		2		1						1				1	1	4		5	1	3	1	19				2215		198
	B-P	1																						1		1		1		1										2		3		4		11				919		148
	B-J	2																								3				1				1				1	1	3		2		4		9				3212		109
	P-J	6										2						2						4				2												2		4		4		10				40	7	52
TOTAL	H-B	1846		690		1286		1276		1197		1594		1155		648		1288		800		1811		4376		413		476		1771		89		421		399		175		1541		1728		1306		7654		26		148	
	H-P	2520		169		853		1967		504		1550		603		310		1205		408		1624		3786		354		768		942		8		159		56		243		2174		1787		1312		10447		18		67	
	H-J	1703		540		1177		1517		812		1476		785		488		1232		410		1070		3605		840		748		697		144		276		283		183		1497		1561		1008		10016		81		283	
	B-P	2520		169		853		1967		504		1550		603		310		1205		408		1624		3786		354		768		942		8		159		56		243		2174		1787		1312		10447		18		67	
	B-J	1703		540		1177		1517		812		1476		785		488		1232		410		1070		3605		840		748		697		144		276		283		183		1497		1561		1008		10016		81		283	
	P-J	1703		540		1177		1517		812		1476		785		488		1232		410		1070		3605		840		748		697		144		276		283		183		1497		1561		1008		10016		81		283	

APPENDIX E Description of Variables Used In Factor Analysis of State Indices

VARIABLE NUMBER	DESCRIPTION
1	Per capita direct expenditure made for all levels of public education in FY 1964 by state and local governments (S:1, p. 19)
2	Elementary and secondary teachers' salaries in FY 1954 (S:1, p. 42)
3	Elementary and secondary teachers' salaries in FY 1964 (S:1, p. 42)
4	Ratio of teachers' salaries in FY 1964/FY 1954
5	Per pupil state expenditure on public elementary and secondary schools, FY 1966 (S:1, p. 57)
6	Elementary and secondary school enrollment (S:2, p. 123) as a percent of the 1960 population (S:14, p. 1-163)
7	Elementary and secondary school enrollment (S:2, p. 123) as a percent of the 1950 population (S:3, p. 12)
8	Ratio of the 1960 enrollment percentage/1950 enrollment percentage (Variable 6/ Variable 7)
9	Mean I.Q. of the 1959-1962 PhD's from the state's high schools (S:16, p. 36 and unpublished data.)
10	Mean I.Q. of the classmates of the 1959-1962 PhD's from the state's high schools (S:16, p. 36 and unpublished data)
11	Median years of school completed by the population over 25 years of age, 1960 census (S:4, p. 1-248)
12	Percent of the population over 25 years of age who completed high school, 1960 census (S:4, p. 1-248)
13	Percent of 1966 draftees who failed mental tests (S:5, p. 13)
14	Percent of 1966 draftees who are of limited trainability (S:5, p. 13)
15	Percent of 1966 draftees who are mentally and medically disqualified (S:5, p. 13)
16	Total federal per capita expenditures for higher education, FY 1960 (S:6, p. 33)
17	Total state per capita expenditures for higher education, FY 1960 (S:6, p. 33)
18	Total local per capita expenditures for higher education, FY 1960 (S:6, p. 33)
19	Total per capita expenditures for higher education, FY 1960 (Variable 16 + 17 + 18)
20	Percent of personal income spent on higher education, FY 1960 (S:6, p. 59)
21	Per capita expenditures of all institutions of higher education, FY 1960 (S:6, p. 106/ 1960 population)
22	Per capita expenditures of private institutions in FY 1964 (S:5, p. 99/1960 population)
23	Per capita expenditures of public institutions in FY 1964 (S:5, p. 98/1960 population)
24	Per capita federal research and development funds given to institutions of higher education, FY 1965 (S:7, p. 46)
25	Current per capita expense of state for higher education, 1961-1962 (S:1, p. 88/1960 population)
26	1950 and 1955 average opening fall college enrollment per 1,000 (S:8, p. 9010/1950 population)

VARIABLE NUMBER	DESCRIPTION
27	1960 and 1965 average opening fall college enrollment divided by pop. (S:8, p. 9010/ 1960 population)
28	Ratio of fall college enrollment of the 1960's/the 1950's (Variable 27/Variable 26)
29	Average annual BA's divided by population, FY 1948–FY 1955 (S:9/1950 population)
30	Average annual BA's divided by population, FY 1956–FY 1963 (S:9/1960 population)
31	Ratio of average number of BA's, FY 1956–FY 1963/average number of BA's, FY 1948–FY 1955 (Variable 30/Variable 29)
32	Annual average number of PhD's divided by population, FY 1948–FY 1955 (OSP, Doctorate Record File)
33	Annual average number of PhD's divided by population, FY 1956–FY 1963 (OSP, DRF)
34	Ratio of average number of PhD's, FY 1956–FY 1963/FY 1948–FY 1955 (Variable 33/ Variable 32)
35	Ratio of average number of PhD's to average number of BA's, FY 1948–FY 1955 (Variable 32/Variable 29)
36	Ratio of average number of PhD's to average number of BA's, FY 1956–FY 1963 (Variable 33/Variable 30)
37	1960 population (S:14, p. 1–163)
38	1950 population (S:3, p. 12)
39	Net employment change from 1940 to 1950 (S:10, p. 4–1)
40	Net employment change from 1950 to 1960 (S:10, p. 4–1)
41	Percent of 1960 population that is urban (S:2, p. 17)
42	Percent of 1950 population that is urban (S:2, p. 17)
43	Ratio of 1960 urban population/1950 urban population (Variable 41/Variable 42)
44	Rate of population growth, 1960/1950 (Variable 37/Variable 38)
45	Average per capita personal income, 1948–1955 (S:11, p. 15)
46	Average per capita personal income 1956–1963 (S:11, p. 15)
47	Ratio of 1960 personal income/1950 personal income (Variable 46/Variable 45)
48	Per capita personal income for 1929 (S:11, p. 15)
49	Per capita personal income for 1940 (S:11, p. 15)
50	Per capita average value added to goods by manufacture, 1963–1964 (S:2, p. 746–747/ 1960 population)
51	Ratio of growth of manufacture, 1963–1964 average/1954 (S:2, p. 746–747)
52	Population per square mile in 1960 (S:2, p. 15)
53	Per capita expenditures of the state for all government functions, FY 1965 (S:1, p. 19)
54	Per capita federal funds given to state for all research and development purposes, FY 1965 (S:7, p. 46/1960 population)
55	Ratio of the percent of population born in the state of residence in 1960/1950 (S:12, p. 7)
56	Ratio of the percent of population born in state other than that of residence, 1960/1950 (S:12, p. 7)
57	Percent of those born in the state who are living in other states, 1960 (S:12, p. 9/1960 population)
58	Percent of 1960 state population born in another state (S:12, p. 9/1960 population)
59	Net in-migration or out-migration per student studying in home state, Fall 1963 (OSP calculation from S:1, p. 68)
60	Percent of state's population born somewhere other than in state of present residence (S:13, p. 1–750)
61	Percent of state population born in the Northeast (S:13, p. 1–750)
62	Percent of population born in the North Central states (S:13, p. 1–750)
63	Percent of population born in the South (S:13, p. 1–750)
64	Percent of population born in the West (S:13, p. 1–750)
65	Percent of 1959–1962 PhD's receiving PhD in same state as high school (OSP)
66	The state population in 1940 (S:3, p. 12)
67	Percent of 1960 population that is rural nonfarm (S:2, p. 17/1960 population)
68	Percent of 1960 population that is rural farm (S:2, p. 17/1960 population)
69	Percent of the 1940 population born in the state (S:12, p. 7)
70	Percent of the 1940 population born in other state (S:12, p. 7)
71	Net 1960 interstate in-migration or out-migration divided by population (S:12, p. 9/1960 population)
72	Net 1940 interstate in- or out-migration divided by population (S:12, p. 9/1940 population)

VARIABLE NUMBER	DESCRIPTION
73	1920 state population (S:3, p. 12)
74	Total expenditures divided by population for general administration by institutions of higher education, 1960 (S:6, p. 106)
75	Total expenditures on institutional and departmental research divided by population by institutions of higher education, FY 1960 (S:6, p. 106)
76	Total miscellaneous expenditures divided by population by institutions of higher education, FY 1960 (S:6, p. 106)
77	Total expenditures divided by population on libraries by instiutions of higher education, FY 1960 (S:6, p. 106)
78	Total expenditures divided by population on the physical plant and its operation by institutions of higher education, FY 1960 (S:6, p. 106)
79	Total expenditures divided by population on organized research by institutions of higher education, FY 1960 (S:6, p. 106)
80	Percent of the 1940 population enrolled in elementary and secondary schools (S:2, p. 123/1940 population)
81	1940 population density (S:2, p. 15)
82	Average number of BA's granted per year in 1966 and 1967, divided by population (S:9/1960 population)
83	Same as Variable 82, but based on the BA's granted by public institutions only
84	Same as Variable 82, but based on the BA's granted by private institutions only
85	Total number of students born in the state who were enrolled in college in Fall 1963, divided by population (S:1, p. 68/1960 population)
86	FY 1964 expenditures of public institutions of higher education for general administration, divided by population (S:5, p. 98/1960 population)
87	FY 1964 expenditures of public institutions of higher education for instruction and departmental research, divided by pop. (S:5, p. 98/1960 population)
88	FY 1964 expenditures of public institutions of higher education for libraries, divided by population (S:5, p. 98/1960 population)
89	FY 1964 expenditures of public institutions of higher education for the physical plant, divided by population (S:5, p. 98/1960 population)
90	FY 1964 expenditures of public institutions of higher education for organizational research, divided by population (S:5, p. 98/1960 population)
91	FY 1964 miscellaneous expenditures of public institutions of higher education, divided by population (S:5, p. 98/1960 population)
92	1920 population density (S:2, p. 15)
93	The north-south grid of the state center of 1960 population (OSP)
94	Percent of 1960 population 19 years of age or less (S:12, p. 61)
95	Percent of 1960 population age 25 to 64 (S:12, p. 61)
96	Net migration divided by population of undergraduate students of public institutions, Fall 1963 (S:15, p. 36)
97	Net migration divided by population of undergraduate students of private institutions, Fall 1963 (S:15, p. 67)
98	Net migration divided by population of all students from all institutions of higher education, Fall 1963 (S:15, p. 19)
99	Net migration divided by population of all students from all institutions of higher education, 1949 (S:15, p. 110–111)
100	Median age of state's population, 1960 census
101	Net migration divided by population of all students from public institutions of higher education, 1958 (S:15, p. 114–115)
102	Matrix score of all students in public institutions of higher education, 1963 (S:15, p. 118–119)
103	Net migration divided by population of all students from private institutions of higher education, 1963 (S:15, p. 120–121)
104	Matrix score of all students of private institutions of higher education, 1963 (S:15, p. 124–125)
105	Net migration divided by population of all students from private institutions of higher education, 1949 (S:15, p. 124–125)
106	1930 state population (S:3, p. 12)
107	Percent of 1950 population that is rural nonfarm (S:2, p. 17)
108	Percent of 1950 population that is rural farm (S:2, p. 17)
109	Percent of 1930 population born in the state of residence (S:12, p. 7)
110	Percent of 1930 population born in another state (S:12, p. 7)

VARIABLE NUMBER	DESCRIPTION
111	Net in- or out-migration divided by population, 1950 (S:12, p. 9)
112	Net in-or out-migration divided by population, 1930 (S:12, p. 9)
113	Average per capita personal annual income from 1964 to 1967 (S:11, p. 15)
114	Per capita federal expenditures for intramural research and development, FY 1965 (S:7, p. 46)
115	Per capita federal expenditures for industrial research and development, FY 1965 (S:7, p. 46)
116	Per capita federal expenditures for research and development in educational institutions, FY 1965 (S:7, p. 46)
117	Per capita federal expenditures for other nonprofit research and development, FY 1965 (S:7, p. 46)
118	Percent of the 1920 population born in the state of residence (S:12, p. 7)
119	Percent of the 1920 population born in another state (S:12, p. 7)
120	Percent of the population enrolled in elementary and secondary schools in 1930 (S:2, p. 123/1930 population)
121	1930 population density (S:2, p. 15)
122	Average annual MA's granted divided by population FY 1966 and FY 1967 (S:9/1960 population)
123	Average number of MA's awarded annually by public institutions divided by FY 1966 and FY 1967 (S:9/1960 population)
124	Average number of MA's awarded annually by private institutions divided by FY 1966 and FY 1967 (S:9/1960 population)
125	Total students studying in the state divided by population, Fall 1963 (S:1, p. 68/1960 population)
126	FY 1964 expenditures divided by population by private institutions of higher education for general administration (S:5, p. 99)
127	FY 1964 expenditures divided by population by private institutions of higher education for departmental research (S:5, p. 99)
128	FY 1964 expenditures divided by population by private institutions of higher education for libraries (S:5, p. 99)
129	FY 1964 expenditures divided by population by private institutions of higher education for physical plant operation and maintenance (S:5, p. 99)
130	FY 1964 expenditures divided by population by private institutions of higher education for organized research (S:5, p. 99)
131	FY 1964 miscellaneous expenditures divided by population by private institutions of higher education (S:5, p. 99)
132	Average number of PhD's awarded annually divided by population, FY 1966 and FY 1967 (OSP)
133	The east-west grid of the state center of 1960 population (OSP)
134	Percent of 1960 population, age 20 to 24 (S:12, p. 61)
135	Percent of 1960 population, 65 years of age or older (S:12, p. 61)
136	Net migration divided by population of graduate students from public institutions of higher education, Fall 1963 (S:15, p. 51)
137	Net migration divided by population of graduate students from private institutions of higher education, Fall 1963 (S:15, p. 83)
138	Net migration divided by population of all students from all institutions of higher education, 1958 (S:15, p. 110–111)
139	Net migration divided by population of all students from all institutions of higher education, 1938 (S:15, p. 110–111)
140	Net migration divided by population of all students from public institutions of higher education, 1963 (S:15, p. 114–115)
141	Net migration divided by population of all students from public institutions of higher education, 1949 (S:15, p. 114–115)
142	Matrix score of all students in public institutions of higher education, 1949 (S:15, p. 118–119)
143	Net migration divided by population of all students in private institutions of higher education, 1958 (S:15, p. 120–121)
144	Matrix score of all students in private institutions of higher education, 1949 (S:15, p. 124–125)
145	Average annual per capita personal income, 1929–1967 (S:11, p. 15)
146	Average percent of population employed in the state, 1940, 1950, and 1960 employment figures/1960 population (S:10, p. 4–1)

VARIABLE NUMBER	DESCRIPTION
147	State's net per capita in- or out-migration, 1960 (S:12, p. 9)
148	State's net per capita in- or out-migration, 1940 (S:12, p. 9)
149	Percent of 1966 draftees who are employable (S:5, p. 13)
150	Fall 1963 net in- or out-migration of undergraduates in public institutions (S:15, p. 36)
151	Fall 1963 net in- or out-migration of graduate students in public institutions (S:15, p. 51)
152	Fall 1963 net in- or out-migration of undergraduates in private institutions (S:15, p.67)
153	Fall 1963 net in- or out-migration of graduate students in private institutions (S:15, p. 83)
154	East-west grid location of center of state population, 1960 (OSP)
155	North-south grid location of center of state population, 1960 (OSP)

[a]The numbers in parenthesis following "S:" refer to the sources listed at the end of the description.
Note: The variables are based on data found in the sources cited. The reader should be aware that in some variables the data have been reduced by varying amounts: Some have been put on a per capita basis; in others, percentages or ratios have been taken. This has not affected the results since they were used only for a state-to-state comparison. It would take more space than is warranted here to explain the specific details of calculations, but they are available in the files of the Office of Scientific Personnel.

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S:15 Charles S. Gossman, Charles E. Nobbe, Theresa J. Patricelli, Calvin F. Schmid, and Thomas E. Steahr, *Migration of College and University Students in the United States*. (Seattle and London: University of Washington Press, 1968).

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APPENDIX F Factor Analysis Tables and Explanation

FACTOR ANALYSES OF STATE DATA

This account of the factor analyses that were made of the state characteristics data is very brief: The final decision on state composites actually used did not depend directly on the factor analyses. The analyses served, rather, as general background information about the relationships between and among the variables. The extensive statistical data derived in the course of the factor analyses proved useful, however, in deciding on which variables to include in the economic and educational composites.

The analyses were carried out by means of a "canned" program, which performed principal axis solutions and "Varimax" rotations of the factors that it derived. This program could only accommodate as many variables as cases in a given run. In this situation, there were 49 cases (the 48 conterminous states plus the District of Columbia; data on Alaska and Hawaii were not uniformly available). Hence, it was necessary to break up the 155 variables that were available for analysis into batches of not more than 49 each and to run several analyses. Some of the variables were very highly correlated and constituted nearly twin pairs; the parallelism of some of the variables, plus some overlapping, was sufficient to make the first two sets very similar. The result was that the same series of factors emerged from set 1 as from set 2. These factors were clearly identifiable as the same because of the similar variables that had high loadings on the several factors and by the groups of states with high scores on each factor. Some "marker" variables from the first two analyses were included in the later ones to help tie the several analyses together into a consistent conceptual framework. This strategy was partially, but not completely, successful.

A word needs to be said at this point as to why the factors that were isolated in these analyses were not used directly in the state composites that were employed for further interpretation of the migration data. The most important reason is the nature of the factors themselves. Without going into the technicalities of the extraction of the principal components and their rotation into orthogonal or uncorrelated group factors, it can still be appreciated that a series of uncorrelated factors are not terms that yield a familiar or readily understood description of the real world of our experience. The social statistics of our ordinary experience are correlated: Wealth and education are related, although imperfectly; age and income are related curvilinearly, i.e., income typically rises with age until it reaches a maximum and then declines again; younger adults are, on the average, better educated than those of the next older generation; incomes are usually higher in the cities than in the rural areas; and so on throughout all types of social statistics. A greater or lesser degree of correlation is the rule, and when one variable is mentioned, we tend immediately to think of other things that are related to it. However, the products of the fac-

tor analysis procedure used here are orthogonal or uncorrelated factors. Knowledge of one factor tells you absolutely nothing about any of the others. The computer produces a series of such uncorrelated abstractions, and numbers them in the order of the extent to which they account for the covariances found among the original variables. These are highly useful abstractions, particularly to those versed in their manipulation, and mindful of their characteristics and limitations. To others not so familiar, they may convey little or no meaning, or could even be misleading. This is readily illustrated by reference to the residual after such a factor as urban affluence is pulled out. It is almost as if all the states were made equal in the urban affluence factor, and we were to think of the states after this equalization had taken place. What does it mean to compare New York and Mississippi "after they are rendered statistically equal in urban affluence"? The mind boggles; one simply cannot do this in fact, and interpretation of state statistics becomes an impossible task. If Utah and Delaware are statistically rendered equal with respect to higher education, what then do state statistics mean? For interpretability, one needs to deal with variables that can be seen to be descriptive of the states *as they are*, "warts and all," rather than with an abstracted picture of the state after some vital aspect had been removed.

In the text, we have dealt with one first-order abstraction by considering the state composites in pairs, e.g., economic prosperity and strength of the elementary-secondary education system. One of the ways of doing this was to think of support of education in terms of "effort." That is, affluent states can support a given educational establishment rather easily; for a poor state, the same level of support would represent a much greater "level of effort." With these two composite variables set in this particular relationship, the concept is understandable. However, if we had to deal entirely with several such abstractions, most of which were not as clearly meaningful as "level of effort," the conceptual task becomes too great. For interpretability, therefore, composites that have a clearly understood meaning in everyday terms were used, rather than abstractions from these analyses.

For those who might wish to pursue the matter further, however, the results of the five analyses that were run are presented in this appendix. The tables that follow define each factor two ways: in terms of the correlation of each of the variables in a given set with each of the factors derived in a given run; and in terms of the factor scores of the 49 states. Each state is given a score on each factor, determined by the extent to which that state's characteristics are included in each factor. The prosperous industrial and commercial states thus come out high on the "urban affluence" factor, the poorer and more rural states are, of course, low on this factor and are assigned correspondingly low "factor scores." Because five analyses were run, each state comes out with five sets of factor scores, with nine or ten factors per run. Usually the first two, three, or four factors are readily understood and the states' identification with each of them make sense. The remaining factors are frequently less easy to interpret, and it is more difficult to assign meanings to them in terms of state scores. There is one instance, however, when even an eighth-order factor has a rather clear-cut meaning: the "Research and Development" factor, with loadings on little else than federal funds for R&D. Usually, a factor is determined by several variables, and the relationship between these variables is not always immediately apparent. The computer program used for this study extracted ten factors in four of the runs, and stopped with nine in one run. In no case, however, was the tenth factor clearly meaningful. This is because one must think in terms of variation remaining with "all else being equal"—the "all else" being the total of nine orthogonal factors previously extracted. Only a rather weak thread of meaning is left by this stage of the analysis.

SETS 1 AND 2

In Set 1 and Set 2, as indicated above, entirely parallel factors emerged. With one exception, they emerged in the same order. That is, the first, second, third, and fourth factors were essentially the same in meaning on the first two analyses. Then a minor shift in the composition of the sets of variables introduced a change in the order in which the factors were extracted: Factor 5 of Set 1 is the same as Factor 7 of Set 2, and vice versa. Factor 6

is the same in both analyses, as are also Factors 8 and 9. It will be useful to describe these two sets of nine factors before going on to the subsequent analyses.

Factor 1 in both Sets 1 and 2 is clearly "Urban Affluence." The variables that have highest weight on this factor are personal income at various periods of time over the past 20 to 30 years, then percentage of the population living in urban centers, teachers' salaries, PhD's produced per million population, and percentage of the population born in the northeastern states. Negative weights on this factor include growth in personal income, growth in urbanization, growth in manufacturing, and growth in output of undergraduates and PhD's. It is a common occurrence in social statistics that growth and status are inversely related. That is, those at the top have slow growth rates; those at the bottom have higher growth rates, simply because the same amount of growth records as a higher percentage when calculated on a smaller base figure. States high on this factor included New York, New Jersey, Delaware, Connecticut, Massachusetts, Rhode Island, Illinois, and the District of Columbia. States low on this factor were principally southern: Mississippi, Alabama, Arkansas, the Carolinas, Tennessee; and two western states, New Mexico and Utah.

Factor 2 in both runs 1 and 2 was a "Public Education" factor, marked by heavy weights on dollars per capita spent on education, at the elementary-secondary level and higher education level; percentage of the population over 25 who had graduated from high school; and immigration into the states from elsewhere in the United States during the 1950's. Negative weights on this factor were registered by percentage of draftees rejected for mental or medical reasons, growth in personal income, and rate of growth in immigration. States that were high on Factor 2 were all western: Wyoming, Colorado, Montana, Arizona, Utah, Nevada, Washington, Oregon, and California. States low on this public education factor were all eastern or southern: the Carolinas, Georgia, Mississippi, Alabama, Tennessee, Kentucky, the District of Columbia, Pennsylvania, and Massachusetts.

Factor 3 was concerned with "Higher Education," as compared to Factor 2, which stressed public education and was heavily weighted with elementary and secondary school variables. Percentage of personal income spent on higher education, opening fall enrollments in institutions of higher education, graduates at the baccalaureate level, dollars per capita spent on higher education, and number of students coming into the state for higher education; all these had strong positive weights on this factor, whereas negative weights were found on such things as number of draftees disqualified for medical or mental reasons, personal income growth, and growth in immigration. States high on this factor included New Hampshire, Vermont, Massachusetts, the District of Columbia, Colorado, and Utah. States low on the higher education factor included New Jersey, Delaware, and Nevada.

The fourth factor coming out of the first two sets of variables is a bit hard to characterize in a single word. We will call *Factor 4* "Educational Deprivation," as it is related to educational deprivation and is concentrated in the southern states, although not limited to them. States high on this rather negative factor include Delaware, the District of Columbia, South Carolina, Mississippi, Florida, Arizona, and Arkansas. States with negative weights include Maine, New Hampshire, Vermont, Massachusetts, and Utah.

As mentioned earlier, *Factor 5* in Set 1 and *Factor 7* in Set 2 were the same, and reflected another rather negative kind of factor: a declining status and emigration. States high on this factor included Vermont, New Hampshire, Maine, the District of Columbia, and Idaho; states low on this factor included the large industrial states and some midwestern states: New York, Pennsylvania, Illinois, Michigan, Minnesota, Wisconsin, Iowa, Texas, and California.

Factor 6 in both sets is "Population Growth."

Factor 7 in Set 1 and Factor 5 in Set 2 were also readily identifiable as the same factor, chiefly characterized by growth in employment, and with one very heavily weighted state, California. This is an illustration of the extent to which generalizations begin to fail after the first four or five factors have been extracted. It is a residual after the factors of

urban affluence, public education, higher education, and two rather negative-appearing factors had been extracted. What remains happens to strongly characterize only a single state, and with respect to only a single variable in the sets here employed.

Factor 8, "R&D," was also rather unitary, but not profound. It was marked by expenditures (chiefly federal) for research and development, and characterized Massachusetts and Nevada in both sets, and, less clearly, New Mexico, the District of Columbia, and California in one or the other of the two. Florida and Arizona were low on this factor in both sets.

The ninth factor was clear enough, but rather weak. It was characterized by growth in manufacturing, and negatively weighted by value added in manufacture (i.e., manufacturing status). High states included Florida and Arizona; Indiana was markedly low on this factor.

SET 3: "MARKERS" IN A NEW CONTEXT

The third set of variables included a few from the first two sets, which were intended to serve as "marker variables." This they did to some extent, but when inserted into quite a different context, some of them tended to mark nothing but themselves. This was true, for example, of the employment growth factor that uniquely characterized California in the first two sets. The same thing occurred when this variable was included in Set 3; again, it emerged as a rather weak eighth factor. The R&D factor came out more strongly (as *Factor 4*); there were several R&D variables included in Set 3. However, it was still only in fourth place on the list, and characterized only Massachusetts, Maryland, Colorado, and Nevada. *Factor 3*, "Personal Income," which was the center of the urban affluence factor in the first two analyses, came out here in lonely splendor. Personal income, in two different periods, was included as a pair of variables, and both members of this pair appeared with strong positive weights on Factor 3. Negatively weighted in this factor were rurality, population growth during the 1950's, and percentage of the population enrolled in elementary and secondary schools. This latter variable characterizes a young population, and illustrates that states vary widely in age distribution. The richer states are those with more mature adults and fewer children. As is true of nations, so too with states within the United States: Where families are large and young, personal incomes are typically lower.

The variables included in Set 3 allowed a difference between private and public higher education to show. *Factor 1* in Set 3 was, indeed, "Private Higher Education," with an emphasis on the graduate school level. States high on this factor included Massachusetts, Vermont, the District of Columbia, and Utah. States low on this factor were New Jersey, Delaware, Florida, Idaho, Wyoming, and Nevada. In contrast, "Public Higher Education" was *Factor 5* in this set, and characterized western and midwestern states: Colorado, New Mexico, Arizona, Utah, Michigan, and Indiana.

Factor 2 in Set 3 was an "Internal Migration" factor relating principally to the earlier decades of this century. It was heavily weighted by immigration into the states from elsewhere in the United States shown in the 1930 and 1950 censuses. Also included was dollars per capita spent on elementary and secondary education in 1964, no doubt a secondary result of the earlier immigration of young adults. In keeping with the long-term migration trends, most of the states high on this factor were western: Montana, Idaho, Wyoming, Colorado, Arizona, Nevada, and the whole Pacific coast. Oklahoma and the District of Columbia were also included, reflecting the more recent "opening" of Oklahoma to white settlement and to the growth of the federal government in Washington. States low on this factor were all eastern or southern. A more recent migration factor, characterizing the migration around mid-century, would have a different set of states as high and low, respectively.

Factor 6 in the third set of state variables is perhaps best characterized as "The New South" emphasizing the urbanization process. Variables highly weighted on this factor include percentage of the population born in the South, population density (1930 census), in-migration (1950 census), and percentage of the population in the 20 to 24 age bracket. A negative weight was registered for number of baccalaureate degrees granted in 1956-

1963. The high states were Delaware, Maryland, the District of Columbia, Virginia, Florida, and somewhat anomalously, New Mexico. Low states were the Dakotas, Utah, New Hampshire, Vermont, and Massachusetts.

The seventh factor in Set 3 seems to reflect the urban centers of graduate education. It is weighted on PhD's per million population, in-migration for private graduate education, and state population in 1930. Negative weights occur on percentage of rural nonfarm population (1950 census) and percentage of the population emigrating. High states include Massachusetts, New York, Pennsylvania, Illinois, Texas, and California; low states are Maine, New Hampshire, Vermont, Rhode Island, and West Virginia.

The ninth factor, while weak, was clear enough, marked by a positive weight on percentage of the population in the 20 to 24 age bracket and a negative weight on percentage of the population over 65. States high on this youth factor include Rhode Island, Michigan, New Jersey, North Dakota, North Carolina, South Carolina, Arizona, and Utah. The low states were all midwestern: Iowa, Missouri, Nebraska, Kansas, Arkansas, and Oklahoma.

Set 4 The principal factor in Set 4, as in Set 3, was one relating to private higher education, but with emphasis on the undergraduate, rather than the graduate level. The strongest variable in this factor was student migration from high school to the college level. An evident, but weaker variable was the number of baccalaureate degrees granted. Population density in 1920 had a negative weight. States high on this factor were New Hampshire, Vermont, Massachusetts, Rhode Island, North Carolina, Tennessee, Indiana, Utah, and California; low scores were found for Connecticut, New York, New Jersey, Delaware, North Dakota, Montana, Idaho, Wyoming, and Nevada.

The second factor in Set 4 is related to public education, with an emphasis on higher education; as such it is somewhat different from Factor 5 of Set 3. Prominent variables in this factor were dollars per capita for elementary and secondary education, a series of public higher education variables, and in-migration for public higher education. A net general population in-migration around mid-century was noted, while percent of the population born in the state (1940 census) was negatively weighted. States high on this factor were all western: Colorado, Wyoming, Arizona, Utah, Washington, Oregon, and California. Low states were in the East and South: Maine, Massachusetts, Pennsylvania, the District of Columbia, South Carolina, Georgia, Alabama, and Arkansas.

The third factor in Set 4 seems to be primarily one of an aging population, which is chiefly urban and affluent. Median age, percent of the population over 25, mean per capita income, and in-migration during the 1940's and 1950's were the positive variables, while negative weights were recorded for such youth-oriented variables as percentage of the population enrolled in elementary-secondary education, percent under age 19, population growth around mid-century, percent rural, BA's granted per 1,000 population, and percent born in the state. States high on Factor 3 were New Hampshire, Rhode Island, Connecticut, New York, New Jersey, Delaware, the District of Columbia, Nevada, Washington, and Oregon. States low on this factor were the Dakotas, South Carolina, Georgia, Alabama, Mississippi, Arkansas, Louisiana, New Mexico, Arizona, and Utah.

The fourth factor was oriented to undergraduate education, particularly its private sector. It is interesting that the various aspects of the education process come out thus in three of the first four factors in this set. Factor 1 emphasized *private* higher education; Factor 2 public education, with an emphasis on the post-high school level; Factor 4 the undergraduate level, with emphasis on the private institutions. The fourth factor also involves population density of the first third of this century, with subsequent emigration, while rural nonfarm population has a negative weight. States high on this factor include Massachusetts, the District of Columbia, Utah, the Dakotas, and, to a lesser extent, Montana and Vermont. Low-scoring states are Florida, Delaware, Georgia, Nevada, Alabama, and, to a lesser extent, Virginia and West Virginia.

The fifth factor in Set 4 relates primarily to recent growth of employment in the

southern states. No variables had significant negative loadings. High on this factor were the District of Columbia, Florida, Oklahoma, Texas, New Mexico, Arizona, and California. Low were Maine, Vermont, Massachusetts, New York, the Dakotas, and Utah.

The sixth factor, rather weakly marked, seems to represent recent emigration and rural nonfarm population. Maine, Vermont, New Hampshire, West Virginia, Idaho, and Nevada score high, while New York, Pennsylvania, Ohio, Michigan, Illinois, Texas, and California score low.

The seventh factor is even less distinct and seems to represent those aspects of higher education that have a rural orientation, such as agricultural extension work. Money spent on aspects of universities other than libraries, capital improvements, and instructional program come out here, together with federal R&D expenditures and percentage of the population living on farms. Emigration is positively weighted and in-migration from other states in the second quarter of the century negatively weighted. Percent of the population under 20 is also negative. High-scoring states are all midwestern, low-scoring states mostly eastern or southern.

The eighth factor was weak, but clear--the research and development factor that has appeared in each of the previous analyses. The ninth factor was too indefinite to be identified.

SET 5 A fifth set of variables was assembled to try to bring together all of the elements that showed as distinct and interesting factors in the preceding analyses; in this respect, it was successful. On the other hand, nothing distinctively new emerged. It may be looked upon as a reaffirmation of the earlier findings. Nine distinct factors show here, with a somewhat uncertain hint of a tenth. The states with high and low loadings on each of these factors may be readily discerned by reference to the accompanying table of state scores, and will not be listed here. The weightings of the several variables on each factor, also, will not be reiterated. Rather, we will briefly characterize the main aspects of each of the factors in turn.

Factor 1 of Set 5 was clearly a higher education factor, with emphasis on the private institutions. Factor 2 emphasized public higher education, with the "Big 10" states prominent. Factor 3 was the familiar urban affluence or "establishment" factor, including substantial expenditures for elementary and secondary education. Factor 4 relates to economic development, as contrasted with status, and thus is strongly southern-oriented. Factor 5 is a western factor, emphasizing the long-term trend of westward migration, with negative weight on PhD production, still weak in the Rocky Mountain states and strongest in the northeast. The sixth factor stresses youthful population and has a mild negative weight on percentage of population employed. The seventh, in contrast to the sixth factor, emphasizes the states high in manufacturing industry and with strong graduate schools. (The coincidence of these elements may well be causal rather than accidental; whether this is true cannot be determined from these data alone.) The eighth factor was one of employment growth apart from all the preceding variables, and, as usual, California stands out strongly on this axis. The ninth factor was the familiar R&D one. The tenth was too weakly marked for clear identification; its heaviest loading was on high scores on tests taken in high school by the *classmates* of eventual PhD's; secondary loading was found on growth in personal income.

The kinds of factors that emerge in any analysis such as this are, quite obviously, a function of the kinds of variables that have been assembled for analyses. The parallelism of Sets 1 and 2 illustrates one side of this question. The distinctness of the research and development factor in four separate analyses illustrates another: One might expect that R&D would merge with some other variables, particularly if it were strictly true that federal research money "goes where the brains are." The distinctness of this factor here suggests that there are other variables that would have to be included in the analyses, but have been overlooked here, to put this factor in a context sufficient to define causal relationships.

TABLE F-1

Factor Analysis of State Data—Run Number 1

Set 1

Abbreviated Description of Variable	Variable Number	Rotated Factor Matrix: Correlation of Each Variable with Each Factor (decimal omitted) Factor Number 1	2	3	4	5	6	7	8	9	10
1. Per capita expenditures for elem-sec educ, 1964	1	12	91	01	-10	-17	14	09	07	-08	-08
2. Teachers' salary level, 1954	2	69	28	11	18	-25	16	20	18	-08	89
3. Ratio, teachers' salaries, 1964/1954	4	-18	-12	-07	-18	12	-02	-07	-14	04	-82
4. Per pupil expenditure, FY 1966	5	78	86	06	-09	-24	06	00	06	10	04
5. % pop. enrolled in elem-sec schools, 1950	7	-90	05	-12	15	00	-03	03	01	-01	-11
6. Ratio, % urban population, 1960/1950	48	26	00	48	-22	-26	16	-10	15	32	84
7. Mean I.Q. of classmates of PhD's of 1959-62	10	38	77	27	-10	13	07	12	13	01	03
8. % pop. over 25 completing high school, 1960	12	-30	-55	-06	63	-10	18	03	07	02	-03
9. % of draftees of limited trainability, 1966	14	-27	-71	-11	24	21	12	05	12	-01	-21
10. % of draftees mentally and medically disqualified	15	42	00	54	11	-17	-09	36	48	10	-09
11. Per cap federal expenditure for higher educ, 1960	16	-30	86	-08	-15	01	-12	-02	00	-03	03
12. Per cap state expenditure for higher educ, 1960	17	12	20	10	17	-22	-21	75	13	20	-11
13. Per cap local expenditure for higher educ, 1960	18	14	63	36	00	-15	-18	36	38	08	-07
14. Sum of variables 11 to 13	19	-14	06	90	-14	02	-15	04	13	08	-15
15. % personal income spent for higher educ, 1960	20	54	-35	65	16	00	-19	09	24	05	02
16. Per cap expenditure for private higher educ, FY64	22	-28	87	06	-12	-05	13	24	02	-04	-13
17. Per cap expenditure for public higher educ, FY 64	23	10	18	10	02	00	19	-02	90	04	11
18. Per cap federal R&D funds to higher educ, 1965	24	41	11	83	05	01	-13	18	22	-01	-08
19. Per cap state expense for higher educ, 1961-62	25	32	25	82	24	-08	-02	14	01	06	11
20. Average opening fall colle e enroll./pop., 50 + 55	26	-23	-01	-19	00	40	-19	-76	-01	08	-14
21. Ratio, fall college enroll 60 + 65/50 + 55	28	26	12	91	04	04	-01	-04	-04	-05	18
22. Average annual BA's/pop., FY 1948-1955	29	-40	-09	06	-19	06	-62	-16	-25	14	-36
23. Ratio, BA's/pop., FY 1956-1963/1948-1955	31	65	00	49	22	-39	-08	-02	10	-15	-17
24. Average annual PhD's/pop., FY 1948-1955	32	-52	-12	00	33	-01	06	-12	-13	35	-08
25. Ratio, PhD's/pop., FY 1956-1963/1948-1955	34	69	03	17	08	-53	03	03	05	-18	-25
26. Ratio average 1948-1955 PhD's/BA's	35	81	-26	-18	-08	-70	-09	32	-01	08	21
27. Population in 1950	38	07	38	03	05	00	13	82	04	-07	10
28. Net employment change 1950/1940	39	83	-04	23	09	-21	13	16	12	01	24
29. % of population that is urban, 1950	42	-75	21	-16	25	04	08	-17	12	31	-13
30. Ratio population 1960/1950	44	18	43	-23	21	05	70	20	17	16	16
31. Average per cap personal income, 1948-1955	45	89	34	01	12	-03	-02	09	12	-10	07
32. Ratio, personal income average, 1956-63/1948-55	47	-47	-54	14	-08	-01	27	03	28	22	-10
33. Per cap personal income, 1940	49	93	12	10	16	08	01	12	16	-06	00
34. Average per cap value added by manufacture, 1963-64	50	13	-03	04	02	-19	16	-01	-13	-79	04
35. Ratio, growth of manufacture, 1963-64/1954	51	-42	15	-01	29	02	36	10	-04	65	04
36. Population per square mile, 1960	52	39	-21	54	55	19	-28	-01	12	03	05
37. Per cap state expend. for all govt. functions, FY 65	53	43	74	08	06	09	-09	08	30	09	-13
38. Per cap federal R&D funds to state, FY 65	54	22	11	15	36	15	10	15	79	07	14
39. Ratio, % pop. born in state of residence 1960/1950	55	06	37	17	-17	-03	-81	14	-08	-02	05
40. Ratio, % of present state pop. born in other, 60/50	56	-21	-52	-17	-03	02	60	-01	05	-12	-21
41. Percent of 1960 population moving out of state	57	-34	21	23	26	49	-43	-35	05	16	-13
42. Percent of 1960 population moving into state	58	27	63	01	42	39	16	21	19	16	21
43. Net migration per student at home, fall 1963	59	-22	-11	85	-05	00	-03	00	-09	-12	08
44. % 1960 pop. born other than state of residence	60	22	65	-01	41	39	15	19	19	15	21
45. % 1960 population born in Northeast	61	61	-24	06	-18	50	39	16	-03	09	-03
46. % 1960 population born in North Central states	62	-07	88	-05	12	05	-21	05	-09	09	05
47. % 1960 population born in South	63	01	-08	09	79	04	24	15	25	07	25
48. % 1960 population born in West	64	-06	72	-13	07	30	-06	03	31	04	17
49. % PhD's with high school state = PhD state	65	12	03	10	-03	-84	03	28	-07	-13	10

TABLE F-1

Factor Analysis of State Data—Run Number 1—Continued

Set 1	State Scores on Each Factor (decimal omitted) Factor Number									
State	1	2	3	4	5	6	7	8	9	10
Maine	27	-104	-64	-144	193	19	38	-36	-80	-186
New Hampshire	38	-93	150	-250	225	105	38	-41	64	107
Vermont	-43	-38	166	-199	202	37	81	-23	-49	-83
Massachusetts	117	-114	171	-151	-75	-17	-37	217	24	-77
Rhode Island	124	-74	33	114	100	-07	-65	-49	-01	79
Connecticut	195	-70	-53	07	41	80	02	-22	-32	-119
New York	200	-61	-55	-46	-225	-59	-47	22	129	28
New Jersey	201	-83	-175	-48	57	01	-01	-27	63	55
Pennsylvania	72	-114	-52	-63	-114	-63	-43	-12	08	143
Ohio	71	-58	-56	04	-47	21	47	-87	-50	135
Indiana	-25	49	68	62	-72	78	-36	-54	-520	24
Illinois	110	-17	-30	07	-166	-35	-35	30	05	19
Michigan	52	65	-31	-13	-120	-24	20	-69	-75	04
Wisconsin	59	38	-08	-54	-153	23	-95	-26	-30	-66
Minnesota	19	72	22	-62	-106	-04	-74	-22	04	-74
Iowa	17	86	58	-40	-141	-19	-101	-41	-08	-199
Missouri	20	-46	-20	-04	-27	-47	-50	-36	-01	28
North Dakota	-82	88	-09	-71	05	-128	-71	02	98	-137
South Dakota	-55	58	-01	-83	78	-158	-61	-51	54	-27
Nebraska	-35	48	26	-33	-14	-67	-24	-81	32	-02
Kansas	-37	75	32	-04	-06	-19	-12	-45	-17	-19
Delaware	185	33	-141	134	75	187	-36	-82	-53	-191
Maryland	82	-42	-12	15	-27	69	25	166	00	-12
D.C.	211	-107	383	396	138	-197	-05	77	22	34
Virginia	-30	-67	-71	43	35	66	38	-14	-22	-15
West Virginia	-97	-91	-76	28	76	-141	19	-13	-92	72
North Carolina	-119	-102	18	24	-77	32	18	08	-73	09
South Carolina	-139	-139	-35	113	31	65	44	-65	-77	27
Georgia	-101	-114	-12	-17	-31	77	-08	02	71	44
Florida	27	02	-44	101	49	281	65	-125	162	107
Kentucky	-90	-107	-68	15	03	-52	-03	-09	00	-99
Tennessee	-102	-112	-05	63	-28	-21	-12	00	-17	31
Alabama	-144	-139	-64	49	13	-02	63	67	-94	-47
Mississippi	-174	-107	-19	91	-36	-35	-09	-05	135	-268
Arkansas	-144	-83	-26	72	03	-76	-80	-21	164	-46
Louisiana	-76	-64	-04	-06	-72	20	-25	61	-07	73
Oklahoma	-82	49	34	53	-19	-54	-60	-52	19	87
Texas	-39	-42	-33	04	-114	19	72	-54	33	192
Montana	-02	140	-50	-60	67	-139	-45	-50	23	92
Idaho	-61	68	-79	-25	142	-148	51	41	-08	165
Wyoming	18	192	-84	67	87	-166	46	-23	-19	-123
Colorado	-14	150	139	49	-16	113	-10	-67	50	-19
New Mexico	-135	76	-05	02	-31	124	-59	413	31	103
Arizona	-53	143	11	177	48	189	15	-136	178	44
Utah	-100	144	276	-118	-78	179	-33	-13	14	-11
Nevada	57	168	-187	69	190	94	-116	330	-33	-07
Washington	21	159	-04	-35	07	-62	11	-33	-17	137
Oregon	17	174	-19	05	43	-94	-13	-44	-46	66
California	41	111	04	-11	-114	-45	603	93	37	-77

TABLE F-2

Factor Analysis of State Data—Run Number 2

Set 2

Abbreviated Description of Variable	Variable Number	Rotated Factor Matrix: Correlation of Each Variable with Each Factor (decimal omitted) Factor Number 1	2	3	4	5	6	7	8	9	10
1. Per capita expenditures for elem-sec educ, 1964	1	18	90	00	08	10	14	-16	08	-04	-07
2. Teachers' salary level, 1964	3	82	26	05	09	22	15	-26	15	-15	13
3. Ratio, teachers' salaries, 1964/1954	4	-21	-11	-03	-13	-01	01	16	-12	-05	-83
4. Per pupil expenditure, FY 1966	5	81	31	02	-09	06	00	-21	06	03	-02
5. % pop. enrolled in elem-sec schools, 1960	6	-82	30	-11	24	00	09	05	08	02	-06
6. Ratio, % elem-sec enrollment 1960/1950	8	78	24	03	04	-04	09	18	17	-03	11
7. Mean I.Q. of PhD's from state's high schools	9	33	15	-14	06	-18	03	07	51	14	-27
8. Median years school completed by 1960 pop. over 25	11	50	69	22	-04	14	06	13	13	00	05
9. % 1966 draftees failing mental tests	13	-34	-65	-22	41	11	15	-06	03	03	-18
10. % of draftees mentally and medically disqualified	15	-33	-72	-06	14	10	14	24	05	-03	-04
11. Per cap federal expenditure for higher educ, 1960	16	41	-04	55	07	43	-07	-17	43	04	-01
12. Per cap state expenditure for higher educ, 1960	17	-26	89	-07	-10	-02	-09	03	00	00	01
13. Per cap local expenditure for higher educ, 1960	18	12	18	06	17	80	-26	-19	11	09	-11
14. Sum of variables 11 to 13	19	15	62	37	01	42	-16	-13	34	04	-01
15. % personal income spent for higher educ, 1960	20	-13	08	92	-15	11	-05	02	10	03	-12
16. Per cap expenditures for all higher educ, 1960	21	42	10	80	05	23	-16	-05	24	-02	-01
17. Per cap expenditure for private higher educ, FY 64	22	52	-39	66	11	14	-18	00	23	00	05
18. Per cap expenditure for public higher educ, FY 64	23	-21	88	04	-10	24	16	-04	01	-01	-06
19. Per cap federal R&D funds to higher educ, 1965	24	11	15	10	-01	04	19	-01	89	03	13
20. Average opening fall college enroll/pop., 60 + 65	27	27	21	79	26	-32	-03	10	-01	11	12
21. Ratio, fall college enroll 60 + 65/50 + 55	28	-24	00	-09	04	-76	-14	40	01	11	-17
22. Average annual BA's/pop., FY 1956–1963	30	10	09	92	-07	-09	-20	07	-13	02	-02
23. Ratio, BA's/pop., FY 1956–1963/1948–1955	31	-44	-05	15	-15	-15	-56	09	-26	12	-42
24. Average annual PhD's/pop., FY 1956–1963	33	58	00	62	23	-02	-09	-34	06	-19	-01
25. Ratio, PhD's/pop., FY 1956–1963/1948–1955	34	-48	-11	-02	50	-07	09	-01	-11	22	-29
26. Ratio average 1956–1963 PhD's/BA's	36	68	04	21	12	07	09	-49	-02	-25	-04
27. Population in 1960	37	33	-20	-24	-07	41	-12	-68	01	00	09
28. Net employment change 1960/1950	40	10	28	-09	09	83	25	03	03	09	05
29. % of population that is urban, 1960	41	78	01	15	19	16	17	-25	17	05	24
30. Ratio population 1960/1950	44	26	39	-30	25	22	65	05	20	14	14
31. Average per cap personal income, 1956–1963	46	92	21	02	06	11	-03	-02	21	-11	07
32. Ratio, personal income average, 1956–63/1948–55	47	-47	-51	14	-08	13	31	01	19	16	-02
33. Per capita personal income, 1929	48	94	04	12	03	15	-11	-01	13	-07	01
34. Average per cap value added by manufacture, 1963–64	50	12	-02	00	03	-02	15	-16	-14	-89	00
35. Ratio, growth of manufacture, 1963–64/1954	51	-36	15	-02	34	12	38	00	-04	70	07
36. Population per square mile, 1960	52	38	-27	57	48	02	-27	18	15	01	11
37. Per cap state expend. for all govt. functions, FY 65	53	46	69	08	04	14	-13	12	32	05	-11
38. Per cap federal R & D funds to state, FY 65	54	23	05	14	29	21	07	15	80	04	21
39. Ratio, % pop. born in state of residence 1960/1950	55	03	39	23	-15	10	-78	-04	-11	00	04
40. Ratio, % of present state pop. born in other, 1960/1950	56	-22	-52	-20	-04	-01	60	00	07	-10	-22
41. Percent of 1960 population moving out of state	57	-34	21	29	27	-30	-40	51	10	14	-12
42. Percent of 1960 population moving into state	58	33	58	-03	46	23	11	39	23	11	22
43. Net migration per student at home, fall 1963	59	-19	-08	82	-05	-02	05	-04	-08	-08	08
44. % 1960 pop. born other than state of residence	60	28	-61	-05	45	21	11	39	23	10	22
45. % 1960 population born in Northeast	61	61	-27	01	-19	19	36	51	-06	05	-01
46. % 1960 population born in North Central states	62	-01	88	-05	19	06	-22	06	-06	08	03
47. % 1960 population born in South	63	04	-13	06	76	18	20	03	28	01	30
48. % 1960 population born in West	64	-02	72	-14	12	00	-06	28	35	07	13
49. % PhD's with high school state = PhD state	65	14	04	08	-06	23	03	-87	-09	-09	13

TABLE F-2

Factor Analysis of State Data—Run Number 2—Continued

Set 2	State Scores on Each Factor (decimal omitted) Factor Number									
State	1	2	3	4	5	6	7	8	9	10
Maine	02	-95	-50	-125	05	34	168	-26	-51	-183
New Hampshire	54	-74	101	-216	43	101	239	-33	28	31
Vermont	-48	-28	165	-247	100	54	210	-57	-27	-09
Massachusetts	96	-113	195	-145	-07	11	-84	187	15	-75
Rhode Island	129	-75	22	-88	-77	00	85	-59	11	43
Connecticut	189	-81	-42	-22	10	78	63	-42	-41	-58
New York	197	-74	-78	-35	09	-102	-194	38	70	-74
New Jersey	187	-98	-164	-24	08	-21	54	-54	40	25
Pennsylvania	65	-109	-58	-73	-86	-81	-138	06	24	89
Ohio	82	-53	-87	-05	-15	-02	-59	-49	-27	99
Indiana	-24	60	41	81	-22	73	-46	-57	-097	-10
Illinois	116	-23	-31	-02	-37	-44	-155	32	-04	04
Michigan	57	72	-18	-04	-33	-11	-156	-56	-42	-13
Wisconsin	60	28	-01	-65	-102	22	-144	-24	-06	-44
Minnesota	26	70	36	-83	-71	08	-106	-30	36	-40
Iowa	-01	84	73	-46	-71	-06	-121	-41	-08	-139
Missouri	11	-48	-26	00	-53	-58	-32	-19	02	20
North Dakota	-81	85	12	-88	-39	-127	39	-05	79	-137
South Dakota	-49	70	12	-76	-78	-146	84	-15	72	-93
Nebraska	-29	52	38	-33	-32	-65	-18	-82	55	04
Kansas	-28	78	33	14	-09	-19	02	-41	-30	-25
Delaware	175	06	-128	67	-22	164	96	-82	-51	-97
Maryland	68	-47	01	-03	57	67	-04	122	-31	50
D.C.	204	-145	402	351	14	-193	177	102	08	76
Virginia	-32	-70	-76	23	12	51	29	-01	-15	13
West Virginia	-126	-77	-50	-27	-22	-125	69	-34	-35	156
North Carolina	-126	-97	28	-08	-03	54	-93	10	-23	45
South Carolina	-152	-132	-54	104	13	68	-01	-15	-28	-16
Georgia	-95	-118	-65	77	03	58	-43	53	17	-88
Florida	57	-06	-91	153	83	260	39	-102	148	60
Kentucky	-100	-106	-39	-12	-13	-43	03	-26	18	-48
Tennessee	-106	-102	13	32	-25	-07	-31	-16	03	79
Alabama	-164	-133	-13	-41	79	19	24	-23	-60	142
Mississippi	-171	-104	-13	136	36	-33	-04	03	45	-347
Arkansas	-146	-79	-21	153	-43	-71	16	-24	80	-123
Louisiana	-89	-64	-07	-11	26	14	-44	20	-25	88
Oklahoma	-64	51	27	63	-63	-51	-26	-36	24	71
Texas	-17	-35	-54	-12	22	11	-127	-39	76	176
Montana	-07	140	-50	-44	-37	-148	69	-41	28	45
Idaho	-90	84	-74	-23	39	-153	142	23	09	194
Wyoming	03	191	-59	82	44	-168	86	-10	-40	-117
Colorado	07	147	108	54	24	106	02	-76	33	27
New Mexico	-129	72	-01	-16	-33	133	-47	395	42	124
Arizona	-09	134	20	205	-06	204	56	-158	171	55
Utah	-77	164	265	-88	-59	221	-116	11	71	-49
Nevada	75	144	-198	63	-118	67	-192	396	-29	-54
Washington	30	164	-14	01	-28	-59	-21	-27	08	101
Oregon	29	177	-04	27	-32	-82	35	-67	-43	69
California	41	109	-28	-22	606	-66	-112	69	50	-47

TABLE F-3

Factor Analysis of State Data—Run Number 3

Set 3

Abbreviated Description of Variable	Variable Number	Rotated Factor Matrix: Correlation of Each Variable with Each Factor (decimal omitted) Factor Number 1	2	3	4	5	6	7	8	9
1. Average per cap personal income, 1956–1963	46	20	40	80	19	–04	04	22	–05	11
2. Per capita expenditures for elem-sec educ, 1964	1	–17	58	15	17	62	–22	09	–02	13
3. Average annual BA's/pop., FY 1956–1963	30	85	13	–06	–17	12	–39	–08	–09	–10
4. % 1960 population born in South	63	28	14	–07	22	05	87	03	15	01
5. Net employment change 1960/1950	40	–10	34	12	10	11	15	–04	79	06
6. Ratio, % urban population, 1960/1950	43	–25	09	–78	17	21	16	–14	–11	03
7. Percent of 1960 population moving out of state	57	27	39	–53	05	–14	–01	–38	–45	–24
8. Per cap federal R&D funds to higher educ, 1965	24	12	11	10	94	10	08	00	–03	12
9. State population in 1930	106	–06	–28	28	–04	–15	–06	76	04	–01
10. % population that is rural nonfarm, 1950	107	–42	–07	–37	–02	15	–13	–63	01	00
11. % population that is rural farm, 1950	108	–22	–21	–83	–15	–03	–05	–06	–16	–24
12. % population born in state of residence, 1930	109	–08	–93	–27	–12	–02	05	06	–04	–04
13. % 1930 population born in other state	110	09	95	–02	09	08	20	–12	04	–09
14. Net in- or out-migration 1950/pop.	111	04	60	45	19	12	32	05	36	25
15. Net in- or out-migration 1930/pop.	112	07	88	15	04	03	20	11	21	14
16. Average per cap personal income, 1964–1967	113	24	33	82	15	–04	02	24	–03	05
17. Per cap federal expend for intramural R&D, FY65	114	70	13	06	33	–12	49	–09	–05	11
18. Per cap federal expend for industrial R&D, FY65	115	–12	27	09	79	–08	13	02	22	10
19. Per cap federal expend for higher educ R&D, FY65	116	12	11	10	94	10	08	00	–03	12
20. Per cap federal R&D to other nonprofit, FY65	117	54	20	22	25	–12	02	25	35	07
21. % population born in state of residence, 1920	118	–08	–95	–18	–09	–04	15	07	03	–03
22. % population born in other state, 1920	119	09	95	–11	05	06	10	–13	–03	–13
23. % population enrolled in elem-sec schools, 1930	120	–21	10	–85	–15	13	02	02	–03	15
24. Population density, 1930	121	84	17	10	00	–29	35	00	–13	08
25. Average annual MA's/pop., 1966–1967	122	90	27	18	01	10	12	05	–13	07
26. Average annual public inst. MA's/pop., 1966–1967	123	–16	39	–09	–11	80	–05	02	–15	05
27. Average annual private inst. MA's/pop., 1966–1967	124	91	08	21	06	–26	13	03	–05	04
28. Total college students studying in state/pop., 1963	125	82	42	04	02	18	–07	09	08	06
29. Private higher educ expend for gen admin/pop., 1963	126	83	–14	39	04	–27	–16	–05	01	–07
30. Private higher educ expend for dept research/pop., 1963	127	90	–06	30	04	–28	–02	08	–02	01
31. Private higher educ expend for libraries/pop., 1963	128	83	–11	38	04	–28	–11	03	03	03
32. Private higher educ expend for phys plant/pop., 1963	129	86	–10	37	05	–32	–05	01	–03	01
33. Private higher educ expend for organ research/pop., 1963	130	55	–03	41	32	–22	–04	24	30	–02
34. Other expend for private higher educ/pop., 1963	131	85	10	05	–01	–27	32	12	–13	04
35. PhD's/population, FY 1966–1967	132	74	28	29	–03	30	03	31	–05	04
36. E - W grid location of state center of pop., 1960	133	–17	71	–39	21	32	–15	13	13	00
37. % population 20 to 24 years of age, 1960	134	48	–09	–27	26	08	42	–05	21	47
38. % population 65 years or older, 1960	135	09	–03	–16	–34	–06	–02	01	–05	–89
39. Net migration grad students, public inst./pop., 63	136	–23	03	12	03	84	28	00	–02	–04
40. Net migration grad students, private inst./pop., 63	137	71	06	–21	12	–07	–06	49	00	–03
41. Net migration all students, all inst./pop., 1958	138	96	–04	–02	–03	09	09	–13	02	–02
42. Net migration all students, all inst./pop., 1938	139	90	–18	01	04	–01	20	–03	13	–12
43. Migration all students, public inst./pop., 1963	140	13	01	–23	–18	76	–10	–44	01	04
44. Migration all students, public inst./pop., 1949	141	–20	–15	–08	18	81	–13	–22	13	03
45. Matrix score of all students, public inst., 1949	142	–15	20	–32	12	73	08	07	23	00
46. Migration all students, private inst./pop., 1958	143	96	–05	01	00	–09	11	–05	01	–06
47. Matrix score of all students, private inst., 1949	144	56	–40	24	–06	04	00	26	35	–21

TABLE F-3

Factor Analysis of State Data—Run Number 3—Continued

Set 3	State Scores on Each Factor (decimal omitted) Factor Number								
State	1	2	3	4	5	6	7	8	9
Maine	−38	−100	54	−47	−84	−37	−160	16	07
New Hampshire	45	−67	145	−08	−27	−111	−271	60	−85
Vermont	110	−102	40	−07	22	−183	−319	34	−89
Massachusetts	165	−75	94	205	−79	−257	125	87	−26
Rhode Island	30	−44	134	−45	−51	−38	−110	−10	117
Connecticut	−13	−01	182	−30	−79	−78	−07	−20	92
New York	12	−47	129	09	−82	−92	264	−95	90
New Jersey	−128	42	198	−68	−149	50	07	−60	105
Pennsylvania	−05	−86	75	−11	−92	−46	138	−108	08
Ohio	−36	−45	77	−49	−08	66	81	17	−07
Indiana	30	−66	81	−60	201	69	56	−39	−92
Illinois	−21	−21	110	16	−48	−02	185	−75	−32
Michigan	−31	02	92	−72	126	29	89	−63	110
Wisconsin	−17	−54	52	−22	83	−37	61	−65	−35
Minnesota	−14	−07	04	−11	50	−58	59	−42	−30
Iowa	06	−40	08	12	89	−46	63	−102	−212
Missouri	10	−40	15	16	−15	12	74	−10	−245
North Dakota	−29	65	−149	−25	−47	−131	−44	−99	119
South Dakota	−23	88	−102	−44	−87	−123	−51	−60	−35
Nebraska	07	29	−52	−30	01	−71	01	−53	−142
Kansas	−01	57	−28	−33	71	−07	07	−77	−141
Delaware	−109	00	203	−81	80	175	−89	−139	57
Maryland	−31	−104	145	148	68	130	−77	110	−60
D.C.	573	139	17	−04	−172	255	−16	−85	36
Virginia	−29	−114	−33	−13	−34	116	−59	−103	84
West Virginia	−47	−45	−27	−42	−27	04	−121	−41	−24
North Carolina	18	−136	−109	−41	25	40	30	59	128
South Carolina	−16	−150	−131	−42	−53	36	−25	94	136
Georgia	−22	−122	−102	−17	−34	73	21	20	80
Florida	−77	77	34	−82	−82	219	−46	200	−77
Kentucky	−17	−116	−94	−08	−27	03	−10	07	−77
Tennessee	18	−106	−93	−16	−20	77	26	49	−55
Alabama	−34	−105	−110	06	−34	67	07	−12	11
Mississippi	−26	−83	−224	−17	−66	15	41	−52	17
Arkansas	−45	−02	−143	−05	−90	49	10	−72	−208
Louisiana	−14	−88	−54	04	−05	24	44	76	25
Oklahoma	03	127	−109	−60	71	70	39	−35	−141
Texas	−23	−30	−53	−34	−14	32	105	112	61
Montana	−54	157	−56	−42	−71	−94	−63	−17	53
Idaho	−72	183	−112	−02	−198	−71	−12	42	21
Wyoming	−71	215	−09	−82	04	06	−30	−99	85
Colorado	67	108	−03	06	241	−53	−16	38	−33
New Mexico	−30	−16	−80	439	163	134	−63	−128	82
Arizona	14	125	−38	−84	240	77	−62	26	146
Utah	147	−33	−98	−25	221	−211	31	23	219
Nevada	−131	155	16	379	−110	27	−70	−78	54
Washington	−22	163	19	−26	47	−33	34	90	19
Oregon	−17	160	29	−46	68	−52	−06	10	−82
California	−10	153	57	91	14	−22	129	462	−32

TABLE F-4

Factor Analysis of State Data—Run Number 4

Set 4

Abbreviated Description of Variable	Variable Number	Rotated Factor Matrix: Correlation of Each Variable with Each Factor (decimal omitted) Factor Number 1	2	3	4	5	6	7	8	9
1. Average per cap personal income, 1956–1963	46	–25	20	78	32	05	–21	–15	26	02
2. Per capita expenditures for elem-sec educ, 1964	1	–18	90	11	04	–09	–10	08	19	14
3. Average annual BA's/pop., FY 1956–1963	30	46	10	00	83	–15	01	07	–16	07
4. % 1960 population born in South	63	–08	–13	02	11	87	07	03	19	14
5. Net employment change 1960/1950	40	12	49	12	–15	46	01	–30	18	–35
6. Ratio, % urban population, 1960/1950	43	–17	20	–70	–18	26	19	31	–06	03
7. Percent of 1960 population moving out of state	57	–19	02	–30	48	02	51	44	–22	–07
8. Per cap federal R&D funds to higher educ, 1965	24	–08	11	03	12	16	08	–01	86	00
9. State population in 1940	66	03	–22	24	–16	–03	–86	–09	–02	–07
10. % population that is rural nonfarm, 1960	67	10	–16	–43	–41	–29	53	01	–19	08
11. % population that is rural farm, 1960	68	–08	02	–57	–02	–27	08	57	–26	–23
12. % population born in state of residence, 1940	69	35	–55	–46	–36	–29	–22	11	–07	14
13. % population born in other state, 1940	70	–33	54	29	31	48	33	04	02	–13
14. Net in- or out-migration/pop., 1960	71	–16	43	52	–11	43	01	–36	31	07
15. Net in- or out-migration/pop., 1940	72	–29	42	43	18	55	08	–26	14	–07
16. State population in 1920	73	02	–29	22	–14	–10	–85	–03	–05	–02
17. Total 1960 higher educ expend for gen admin/pop.	74	33	–05	33	79	–09	05	–14	12	03
18. Tot 1960 higher educ expend for inst & dept research/pop.	75	27	26	18	87	–09	–08	–08	10	–01
19. Total other expend by higher educ, 1960/pop.	76	25	–05	09	63	33	00	52	04	16
20. Total 1960 higher educ expend for libraries/pop.	77	37	10	37	72	00	11	–13	23	–07
21. Total 1960 higher educ expend, phys plant & operation/pop.	78	24	09	18	82	–28	08	–17	17	00
22. Total 1960 higher educ expend for organized research/pop.	79	16	16	27	37	13	–29	–17	59	–20
23. % pop. enrolled elem-sec schools, 1940	80	–03	01	–85	–21	16	13	14	–15	–06
24. Population density, 1940	81	02	–32	21	79	39	08	04	05	09
25. Average annual BA's, FY 1966–1967/pop.	82	42	26	–07	76	–05	21	05	–09	08
26. Average annual BA's, public inst, FY 1966–67/pop.	83	–08	78	–42	03	–17	12	13	–26	10
27. Average annual BA's, private inst, FY 1966–67/pop.	84	44	–32	28	77	02	–03	–07	07	02
28. Total fall, 63 college students born in state/pop.	85	–28	65	15	36	12	–34	–16	09	–28
29. FY 64 public inst expend for gen admin/pop.	86	–07	84	03	–09	–12	22	–05	–08	10
30. FY 64 public inst expend for instruct & dept research/pop.	87	–04	94	–18	02	–09	09	04	–06	10
31. FY 64 public inst expend for libraries/pop.	88	–04	85	01	–12	05	26	07	15	00
32. FY 64 public inst expend for physical plant/pop.	89	–22	80	–28	08	–24	20	01	03	05
33. FY 64 public inst expend for organized research/pop.	90	15	81	–09	–08	19	–08	03	33	–12
34. Other FY 64 expend by public inst high ed/pop.	91	16	34	–11	–29	–05	16	78	03	08
35. Population density, 1920	92	02	–33	21	79	38	08	04	05	09
36. N - S grid location of state center of pop., 1960	93	14	–23	–41	–31	71	–13	00	–01	–04
37. % 1960 population up to 19 years of age	94	–05	26	–81	–22	–22	03	–25	18	16
38. % 1960 population age 25–64	95	–15	–25	85	14	19	–25	–01	05	–06
39. Migration undergrads public inst/pop., fall, 1963	96	34	48	–38	13	–01	27	–09	–26	50
40. Migration undergrads private inst/pop., fall, 1963	97	88	03	–14	24	–26	07	–05	–02	01
41. Net migration, all students, all inst., 1963/pop.	98	74	–09	–03	37	15	02	09	–12	25
42. Net migration, all students, all inst., 1949/pop.	99	57	–01	01	08	28	00	12	26	36
43. Median age, 1960 census	100	03	–17	87	15	–08	–15	05	–16	–20
44. Migration, all students, public inst., 1958/pop.	101	34	40	–23	26	18	10	01	–08	65
45. Matrix of all students, public inst., 1963	102	16	66	–48	–10	26	–10	27	–09	07
46. Migration, all students, private inst., 1963/pop.	103	83	–09	–08	47	–09	02	–02	01	01
47. Matrix of all students, private inst., 1963	104	81	–24	00	27	04	–16	08	–03	–15
48. Migration, all students, private inst., 1949/pop.	105	89	–12	08	28	–03	–05	00	–01	05

TABLE F-4

Factor Analysis of State Data—Run Number 4—Continued

Set 4	State Scores on Each Factor (decimal omitted) Factor Number								
State	1	2	3	4	5	6	7	8	9
Maine	04	−102	45	−74	−127	142	−100	−40	48
New Hampshire	167	−21	123	−05	−90	174	−80	−25	60
Vermont	226	57	06	70	−195	181	−86	−35	60
Massachusetts	134	−110	49	119	−137	−58	−132	227	−140
Rhode Island	102	−67	107	04	−54	88	−117	05	−05
Connecticut	−128	−73	101	37	−73	01	−133	26	−76
New York	−108	−60	105	36	−100	−323	−69	−42	25
New Jersey	−198	−90	127	−36	26	−72	−87	−20	10
Pennsylvania	−32	−126	76	−05	−75	−192	−29	−61	60
Ohio	11	−43	59	−54	19	−118	−60	−66	78
Indiana	121	41	56	−31	−08	−31	60	−28	37
Illinois	−49	−36	87	04	−57	−176	32	74	−42
Michigan	−30	81	21	−06	−39	−109	−82	05	162
Wisconsin	12	29	27	−28	−81	−70	74	−01	22
Minnesota	31	47	24	−12	−89	−51	154	66	07
Iowa	86	10	37	−08	−86	−46	318	71	−90
Missouri	86	−59	82	−46	17	−19	87	−64	−27
North Dakota	−186	73	−175	120	−157	−12	84	−34	37
South Dakota	−59	23	−88	92	−113	46	44	−89	−86
Nebraska	38	44	−08	38	−51	01	145	−110	−90
Kansas	10	90	−04	38	01	−27	119	−84	−45
Delaware	−145	28	117	−86	02	90	−44	−05	203
Maryland	−44	−44	68	−51	25	01	37	235	94
D.C.	16	−193	114	543	281	70	54	19	62
Virginia	−37	−75	−05	−72	25	16	89	24	23
West Virginia	−06	−91	−26	−76	−24	113	−37	−78	51
North Carolina	117	−73	−88	−70	45	−08	34	29	13
South Carolina	54	−134	−168	−73	28	46	−104	05	03
Georgia	18	−111	−86	−89	62	−08	22	22	56
Florida	24	−18	89	−131	257	91	−118	−87	−154
Kentucky	30	−79	−58	−63	−26	19	54	−55	−11
Tennessee	111	−87	−45	−60	84	−05	44	−49	−25
Alabama	01	−114	−101	−74	38	08	57	11	33
Mississippi	−39	−86	−243	−13	31	−14	31	−42	−36
Arkansas	−21	−97	−107	−32	43	47	84	−83	−145
Louisiana	65	−32	−85	−46	38	−06	−105	24	05
Oklahoma	01	50	−38	21	137	−21	111	−137	−44
Texas	38	−06	−67	−49	111	−153	−60	−51	−33
Montana	−156	84	−45	68	−89	64	−55	−64	−41
Idaho	−153	11	−75	43	−54	109	−47	25	−199
Wyoming	−175	120	−10	48	−09	87	−18	−75	−76
Colorado	81	182	66	04	87	00	154	−31	271
New Mexico	−74	42	−194	−33	103	41	22	425	149
Arizona	−74	177	−105	18	186	−14	−175	−134	164
Utah	166	200	−216	177	−107	−86	−175	39	13
Nevada	−172	84	131	−59	27	201	64	177	−123
Washington	−04	151	101	−14	−19	45	−21	−12	−11
Oregon	20	140	138	−28	05	87	67	−29	36
California	119	263	81	−54	183	−148	−110	123	−282

TABLE F-5

Factor Analysis of State Data—Run Number 5

Set 5

Abbreviated Description of Variable	Variable Number	Rotated Factor Matrix: Correlation of Each Variable with Each Factor (decimal omitted) Factor Number 1	2	3	4	5	6	7	8	9	10
1. Average annual per cap personal income, 1929–1967	145	21	07	92	–13	–02	–07	00	–01	10	–13
2. Ratio, personal income average, 1956–63/1948–55	47	00	–41	–40	28	03	07	–10	11	12	43
3. Average per cap value added by manufacture, 1963–64	50	–04	–16	21	–11	–19	–04	78	–16	01	–06
4. Ratio, growth of manufacture, 1963–64/1954	51	–09	28	–27	58	07	26	–39	25	–12	20
5. Average % pop. employed 1940–1960/1960 pop.	146	54	–42	00	–39	10	–40	–13	–20	–09	–26
6. Net employment change 1960/1950	40	–10	25	27	26	–14	04	00	81	03	00
7. Ratio population 1960/1950	44	–31	32	50	47	07	26	07	26	14	21
8. Net in- or out-migration, 1960/pop.	147	–12	28	76	31	04	17	11	28	21	–02
9. Net in- or out-migration, 1940/pop.	148	09	42	63	37	11	–01	–06	23	17	–25
10. % 1966 employable draftees	149	11	60	34	–52	03	–22	10	01	02	22
11. Mean I.Q. of classmates of PhD's of 1959–62	10	35	–03	29	01	–16	–07	–14	–03	18	64
12. % pop. over 25 completing high school, 1960	12	26	68	49	–20	09	03	–02	15	17	06
13. Average annual PhD's/pop., FY 1956–1963	33	72	–04	48	01	–30	–08	14	–11	–02	–03
14. Average annual BA's/pop., FY 1956–1963	30	90	15	–08	–23	06	–09	01	–04	–17	14
15. Average annual MA's/pop., FY 1966–1967	122	88	05	32	20	09	–01	09	–11	–06	–09
16. Per cap expenditures for all higher educ., 1960	21	88	09	32	–10	–09	00	–05	16	13	00
17. % personal income spent for higher educ., 1960	20	84	11	–24	–20	00	15	01	19	02	21
18. Average opening fall college enroll/pop., 1960 + 65	27	82	27	16	09	21	05	01	–28	–15	11
19. Net migration per student at home, fall 1963	59	75	00	–32	00	–07	–08	28	07	00	28
20. % PhD's with high school state = PhD state	65	07	01	18	04	–91	–08	11	10	–07	09
21. Average annual public inst. MA's/pop., 1966–1967	123	–08	72	03	12	–06	20	43	–18	–29	16
22. Average annual BA's, public inst., FY 1966–67/pop.	83	–09	82	–30	–14	07	16	02	00	–30	18
23. Per cap expenditure for public higher educ. FY 64	23	–09	86	–04	–09	–09	18	16	27	–02	09
24. Net in- or out-migration, undergrads, public inst., 1963	150	09	37	–45	18	18	06	52	31	–13	–04
25. Net migration, grad students, public inst., fall 1963	151	00	38	–12	12	–01	–01	71	45	–05	–07
26. Average annual private inst. MA's/pop., FY 1966–1967	124	86	–26	28	14	11	–10	–11	–02	07	–16
27. Average annual BA's, private inst., FY 1966–1967/pop.	84	89	–32	19	–08	06	–12	–01	01	03	06
28. Per cap expenditure for private higher educ., FY 64	22	80	–38	35	01	–02	–11	–11	06	17	–03
29. Net migration undergrads, private inst., fall 1963	152	55	06	–42	01	–08	–16	43	04	31	04
30. Net migration grad students, private inst., fall 1963	153	71	–08	07	10	–19	–09	–20	–25	27	–08
31. Per capita expenditures for elem-sec educ., 1964	1	–05	82	34	–16	–15	25	10	04	–01	06
32. Teachers' salary level, 1964	3	18	12	91	02	–24	14	11	06	07	–03
33. % pop. enrolled in elem-sec schools, 1960	6	–21	41	–67	29	05	30	04	–01	10	–16
34. Per pupil expenditure, FY 1966	5	12	16	83	–22	–15	09	–14	–09	–11	10
35. Ratio, % elem-sec enrollment 1960/1950	8	13	13	80	–08	21	–10	04	03	13	06
36. Per cap federal R&D funds to higher educ., 1965	24	13	13	24	16	07	26	00	01	74	22
37. % of population that is urban, 1960	41	28	–05	84	22	–21	03	–03	01	06	14
38. Percent of 1960 population moving into state	58	05	57	50	40	38	–07	–03	21	20	–11
39. Percent of 1960 population moving out of state	57	31	35	–44	05	53	–30	–17	–28	04	–14
40. % 1930 population born in other state	110	13	73	30	28	31	–26	–10	10	09	–21
41. % 1960 population up to 19 years of age	94	–22	23	–52	–04	–04	74	00	05	–02	09
42. % population 65 years or older, 1960	135	08	00	–33	–07	–10	–84	08	–01	–23	11
43. % 1960 population born in Northeast	61	03	–40	56	–10	53	06	01	35	–12	21
44. % 1960 population born in North Central states	62	–05	91	11	01	02	–20	–03	02	00	–15
45. % 1960 population born in South	63	16	–05	18	86	08	–08	08	06	14	–10
46. % 1960 population born in West	64	–09	72	14	02	25	12	–11	00	45	–18
47. E - W grid location of state center of pop., 1960	154	–07	91	–08	09	–10	04	–10	06	21	–09
48. N - S grid location of state center of pop., 1960	155	–16	–20	–29	83	–20	01	01	05	00	15

TABLE F-5

Factor Analysis of State Data—Run Number 5—Continued

Set 5	State Scores on Each Factor (decimal omitted) Factor Number									
State	1	2	3	4	5	6	7	8	9	10
Maine	-60	-100	-47	-138	106	-22	36	64	05	-51
New Hampshire	42	-90	23	-132	233	-63	41	124	19	296
Vermont	118	-65	-90	-193	178	24	01	174	-43	68
Massachusetts	193	-121	37	-104	-80	36	04	13	229	101
Rhode Island	27	-105	89	-94	94	03	67	00	-35	62
Connecticut	-18	-121	167	-51	75	98	16	31	-69	-58
New York	08	-95	191	-61	-180	70	-273	-254	-12	38
New Jersey	-160	-133	221	-38	106	45	-102	18	-171	-27
Pennsylvania	-17	-107	37	-58	-124	-66	-63	-141	89	30
Ohio	-50	-50	62	-03	-38	-48	84	-04	13	06
Indiana	09	-11	49	-23	-75	-44	523	-130	45	-34
Illinois	-23	-46	124	-27	-123	-40	-83	-114	28	00
Michigan	-02	35	72	-21	-110	127	146	-07	-126	-80
Wisconsin	-10	16	27	-86	-107	-15	74	-19	-59	50
Minnesota	09	47	02	-115	-97	15	-02	25	-40	06
Iowa	36	52	-47	-107	-124	-128	13	11	-12	26
Missouri	-17	-16	-23	20	-50	-218	02	-70	26	48
North Dakota	10	89	-108	-137	54	87	-91	-33	-88	-03
South Dakota	18	88	-92	-111	79	-41	-63	-21	-56	01
Nebraska	16	78	-70	-66	-36	-159	-49	-09	-66	43
Kansas	05	110	-23	-07	-11	-142	34	-77	-87	79
Delaware	-104	-39	152	35	109	70	76	-17	-123	-87
Maryland	-36	-79	110	15	18	41	17	76	45	49
D.C.	531	-92	120	203	127	-106	-53	-30	08	-207
Virginia	-80	-79	-11	26	22	18	-17	38	-16	-30
West Virginia	-50	-56	-121	16	65	-05	50	-54	-31	-111
North Carolina	22	-89	-125	34	-87	101	58	77	19	-87
South Carolina	-34	-132	-148	54	15	155	-08	33	13	-190
Georgia	-48	-102	-96	85	-21	22	-32	-11	51	57
Florida	-108	-26	102	288	25	-148	-63	187	-55	151
Kentucky	-50	-69	-127	20	-28	-56	-07	-19	-25	-23
Tennessee	00	-77	-113	86	-37	-46	27	03	31	-01
Alabama	-45	-95	-139	73	-41	52	-05	08	-12	-97
Mississippi	-14	-71	-203	73	06	62	-51	-16	-25	-23
Arkansas	-42	-31	-162	80	50	-143	-67	-53	-05	56
Louisiana	-16	-57	-53	91	-98	79	-12	-20	-05	65
Oklahoma	07	89	-57	101	07	-179	12	-60	-86	35
Texas	-38	-14	-05	86	-134	02	-36	17	-15	40
Montana	-28	137	-09	-115	42	-15	-85	-08	-06	-94
Idaho	-53	101	-63	-49	111	-03	-104	05	151	-133
Wyoming	-19	173	12	-38	63	19	-44	-42	15	-228
Colorado	74	182	30	81	15	01	13	00	-89	98
New Mexico	-30	82	-28	138	42	214	19	-65	275	178
Arizona	-05	178	52	249	110	166	35	-43	-180	77
Utah	187	155	-67	-52	-81	297	-17	-04	-52	194
Nevada	-137	121	121	51	193	-17	02	-60	385	-39
Washington	-13	148	61	-66	-22	-30	-10	40	45	-60
Oregon	-02	180	65	-50	16	-46	23	-38	09	-91
California	00	106	104	21	-259	-26	-37	475	91	-101

APPENDIX G Standard Score Scales for State Indices and State Index Ratios

Chapter IV describes the development of three state indices that were cast into comparable standard score form. The procedure for this standardization is described here.

The weighted sum of the variables comprising each index was computed for each state. In the case of the economic prosperity index, these state scores varied from 312 to 772, with a mean of 510. For the higher education index, the range was from 183 to 796 with a mean of 339 and for the elementary-secondary school index from 285 to 981 with a mean of 634. Although of the same order of magnitude, these obviously are not directly comparable. To convert them to comparable scales, linear transforms were made, setting the mean of each index at 500, with a standard deviation of 100. This is the same statistical format as that used for such familiar scales as the College Board Scores or the Graduate Record Examinations. Using these transformed standard score scales, it becomes possible to make direct comparisons of the scores on one scale with those of another. The original raw scores and transformed standard score scales for each index are given in Table G-1.

For further information about each state, some ratios were calculated and are presented in Table G-2. These additional variables give such measures as "effort" for support of elementary-secondary or higher education or the relative emphasis placed on each of these educational levels by each state. Other ratios relate to migration statistics such as origins-destinations ratios. The detailed description of each of these additional ratio indices follows:

1. S/E ratio: Elementary-secondary school index (S) divided by economic prosperity index (E). Both indices are expressed in standard score terms. This is one type of "effort" index and is comparable to the distance from the diagonal in Figure 22 (p. 70).
2. H/E ratio: Higher education index (H) divided by economic prosperity index (E). This is comparable to distance from the diagonal in Figure 21 (p. 69).
3. S/H ratio: Elementary-secondary index divided by higher education index. This can be equated to distance from the diagonal in Figure 23 (p. 72) and is a measure of relative emphasis on these two educational levels.
4. HS/BA ratio: The number of eventual PhD's graduating from high school in a given state divided by the number who take baccalaureate degrees in that state. This index correlates 0.48 with the S/H ratio, column 3, and corresponds with the ratio of the height of the first bar to the height of the second bar in each set in Figure 13 (p. 42–43).
5. BA/PhD ratio: The number of eventual PhD's who take baccalaureate degrees in a state divided by the number of PhD's granted in that state. See Table 13 (p. 36) for the

reciprocals of these ratios, calculated for each census region for each decade. The data here are for 1960-1967.

6. Exchange index: A measure of the extent of state-to-state student interchange across all levels from high school to post-PhD employment. It is obtained by counting the number of states with which each state exchanges students at any stage and dividing, by 51, the total number of states (including the District of Columbia). The obverse of this would be an "insularity index," which could be obtained by counting the number of blank cells for each state in the "block diagrams" of Appendix D.

7. HS/Job ratio: The ratio of eventual PhD's graduating from high school in a given state to the number eventually employed in that state. Because of the fact that about 20 percent of the PhD's do not know where they will eventually be employed, the high school numbers have also been reduced by 20 percent to keep the index balanced.

8. PhD/Job ratio: As for HS/Job ratio in number seven, the PhD figures in this ratio are multiplied by 0.8.

TABLE G-1

Composite Indices for Each State, in Raw Score and Standard Scaled Score Terms, on Per Capita Economic, Higher Education, and Elementary-Secondary Variables

	Per Capita Scales of					
	Economic Prosperity		Higher Education Development		Elementary-Secondary Educational System	
State	Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score
Maine	460	457	246	414	544	448
New Hampshire	546	531	412	568	576	467
Vermont	479	474	529	677	603	482
Massachusetts	637	609	559	705	683	528
Rhode Island	603	580	348	509	589	474
Connecticut	741	699	311	475	723	551
New York	684	650	326	488	792	591
New Jersey	696	660	192	364	653	511
Pennsylvania	585	565	283	449	613	488
Ohio	610	586	246	414	633	499
Indiana	596	574	368	528	751	567
Illinois	695	659	333	495	712	545
Michigan	624	598	336	498	793	591
Wisconsin	576	557	322	485	758	571
Minnesota	517	506	384	542	795	592
Iowa	532	519	413	569	723	551
Missouri	545	530	285	450	541	447
North Dakota	395	402	368	528	635	501
South Dakota	408	413	400	557	589	474
Nebraska	512	502	355	515	632	499
Kansas	511	501	368	528	718	548
Delaware	698	662	188	360	817	605
Maryland	574	555	345	506	662	516
D.C.	772	725	796	925	626	495
Virginia	451	450	259	426	512	430
West Virginia	413	417	219	389	394	362
North Carolina	420	423	346	507	423	379
South Carolina	381	390	246	414	299	307
Georgia	422	425	247	415	384	356
Florida	393	400	207	378	595	478
Kentucky	402	408	240	409	370	348
Tennessee	405	410	306	470	360	342
Alabama	369	379	261	428	350	337
Mississippi	312	330	304	468	285	299
Arkansas	354	366	282	448	314	316
Louisiana	377	386	329	491	478	410
Oklahoma	423	426	353	514	585	472
Texas	457	455	269	436	557	456
Montana	480	475	322	485	740	561
Idaho	437	438	279	445	596	478
Wyoming	505	496	320	483	817	605
Colorado	500	492	442	596	866	633
New Mexico	343	357	304	468	800	595
Arizona	392	399	313	476	784	586
Utah	429	431	606	749	888	646
Nevada	601	579	183	356	815	604
Washington	578	559	336	498	855	627
Oregon	542	528	352	513	877	640
California	621	596	394	552	981	699

TABLE G-2

State Index Ratios

State	1 S/E	2 H/E	3 S/H	4 HS/BA	5 BA/PhD	6 Exchange Index	7 HS/Job	8 PhD/Job
Maine	0.98	0.91	1.08	0.86	21.59	0.78	1.40	0.09
New Hampshire	0.88	1.07	0.82	0.87	6.64	0.84	1.61	0.29
Vermont	1.02	1.43	0.71	0.75	8.98	0.72	1.14	0.18
Massachusetts	0.87	1.16	0.75	0.67	0.90	1.00	0.78	1.28
Rhode Island	0.82	0.88	0.93	0.79	1.34	0.80	1.11	1.05
Connecticut	0.79	0.68	1.16	0.96	0.74	0.94	0.87	1.22
New York	0.91	0.75	1.21	1.16	1.07	1.00	1.42	1.19
New Jersey	0.77	0.55	1.40	1.73	0.91	1.00	0.90	0.58
Pennsylvania	0.86	0.79	1.09	1.03	1.20	1.00	1.23	1.01
Ohio	0.85	0.71	1.21	0.93	1.32	1.00	1.12	0.89
Indiana	0.99	0.92	1.07	0.76	0.69	1.00	0.93	1.83
Illinois	0.83	0.75	1.10	1.10	0.85	1.00	1.29	1.39
Michigan	0.99	0.83	1.19	0.89	0.75	1.00	0.93	1.33
Wisconsin	1.03	0.87	1.18	1.08	0.72	1.00	1.13	1.38
Minnesota	1.17	1.07	1.09	0.94	1.19	1.00	1.34	1.14
Iowa	1.06	1.10	0.97	0.94	0.80	1.00	1.48	1.99
Missouri	0.84	0.85	0.99	1.08	1.26	1.00	1.31	0.95
North Dakota	1.25	1.31	0.95	1.45	2.08	0.86	1.98	0.68
South Dakota	1.15	1.35	0.85	1.24	5.98	0.84	1.83	0.28
Nebraska	0.99	1.03	0.97	1.13	1.55	0.92	1.78	1.05
Kansas	1.09	1.05	1.04	1.02	1.59	1.00	1.40	0.83
Delaware	0.91	0.54	1.68	1.54	0.62	0.74	0.25	0.27
Maryland	0.93	0.91	1.02	0.89	0.74	0.94	0.47	0.73
D.C.	0.68	1.28	0.54	0.90	0.43	0.90	0.27	0.70
Virginia	0.96	0.95	1.01	1.11	1.52	0.90	0.91	0.55
West Virginia	0.87	0.93	0.93	1.20	4.11	0.92	1.74	0.35
North Carolina	0.90	1.20	0.75	0.80	0.73	1.00	0.69	1.16
South Carolina	0.79	1.06	0.74	0.98	4.08	0.78	1.01	0.27
Georgia	0.84	0.98	0.86	0.98	1.51	0.84	0.85	0.63
Florida	1.20	0.95	1.26	1.15	0.65	0.92	0.77	1.02
Kentucky	0.85	1.00	0.85	1.05	2.38	0.88	1.23	0.53
Tennessee	0.83	1.15	0.73	0.90	1.03	0.98	0.78	0.83
Alabama	0.89	1.13	0.79	1.00	1.92	0.76	1.18	0.63
Mississippi	0.91	1.42	0.64	1.19	2.09	0.80	1.27	0.54
Arkansas	0.86	1.22	0.71	1.21	1.96	0.88	1.88	0.84
Louisiana	1.06	1.27	0.84	0.93	1.07	0.94	0.78	0.77
Oklahoma	1.11	1.21	0.92	1.00	1.12	0.98	1.35	1.20
Texas	1.00	0.96	1.05	0.99	1.16	0.98	0.96	0.80
Montana	1.18	1.02	1.16	1.24	2.65	0.92	1.51	0.51
Idaho	1.09	1.02	1.07	1.66	7.11	0.88	1.87	0.14
Wyoming	1.22	0.97	1.25	1.55	0.72	0.88	1.19	1.12
Colorado	1.29	1.21	1.06	0.78	0.71	1.00	0.64	1.16
New Mexico	1.67	1.31	1.27	0.92	1.17	0.88	0.36	0.33
Arizona	1.47	1.19	1.23	0.94	0.62	0.86	0.48	0.77
Utah	1.50	1.74	0.86	0.76	1.89	0.90	1.53	0.94
Nevada	1.04	0.61	1.70	1.42	10.88	0.78	0.70	0.06
Washington	1.12	0.89	1.26	1.04	0.97	0.98	0.91	0.91
Oregon	1.21	0.97	1.25	0.88	1.00	0.90	0.91	1.04
California	1.17	0.93	1.27	0.90	0.73	1.00	0.55	0.88

APPENDIX H Mobility in Five Dimensions

The two tables in this appendix show the number moving into and out of each state at each of three career transitions and the mean amount and direction of movement at each of these transitions *for those who moved.* Those who did not move are omitted from the latter calculations; that is, they are not included in the denominator in computing average characteristics. "Movement" as used here refers not only to geographic direction but also to change in the three indices of state characteristics: (E) economic prosperity, (H) higher education development, and (S) elementary-secondary school strength.

Appendix Table H-1 is based on the movements of all the 1957-1967 PhD's whose origins and destinations were within the United States. Each of three career transitions is shown: high school to college (abbreviated HS-BA); undergraduate school to school of doctorate (BA-PhD); and from PhD to first post-PhD employment (PhD-Job). Each state is shown as a state of origin and as a state of destination at each of these stages. Within each career stage, the first column gives the number of eventual PhD's in the state before (origin) and after (destination) each transition. The second column shows the number moving out (top line), the number moving in (second line), and the net change (bottom line). The third column translates column 2 into percentages of the origins figure, thus showing percentage of gain or loss. For example, Maine was the origin at the high school level of 503 people who eventually earned PhD's. To go to college, 189 of these (37.6 percent) left Maine, while 269 other eventual PhD's came to Maine to earn baccalaureates, for a net gain of 80 at this stage. The gross gain at this stage was 53.5 percent (269/503), and the net gain, shown on the third line, was 15.9 percent (80/503). A similar set of figures is given for the BA-to-PhD transition. At this stage, most eventual PhD's left Maine to go elsewhere to graduate school. Thus, of the 583 with Maine BA's, 575 or 98.6 percent left, while 19 or 3.3 percent of 583 came to Maine to earn PhD's. At this stage, the net loss was 556 people, or 95.3 percent of 583. For eventual employment, the tide changed again. Here we begin with 25, instead of the 27 with Maine PhD's, because the destinations of two of these people is unknown. They may have stayed in Maine, or may have gone elsewhere; the information is missing. Of the 25 with known post-PhD locations, 19 or 76 percent left and 6 or 24 percent stayed in Maine for employment, while 282 or 1,128 percent of 25 came to Maine for jobs, after earning doctorates elsewhere. The net gain looms large as a percentage of 25 PhD's, but the number represents only a fraction of the 503 with which we began back at the high school stage.

There are a few inconsistencies in the data, as indicated above, because of missing information. However, this is characteristic only of the PhD-to-job transition and occurs because about one in five PhD's does not know, when he completes the Doctorate Survey

form, just where he would be located after graduation. This lack of information tends to inflate the gain or loss percentages by one fourth because the origins figures (state of PhD) are always known, while the numerator of this ratio (state of eventual job) is systematically understated. This does not invalidate the state-to-state comparisons, however, as it can be assumed that all states are affected to about the same extent by this uncertainty.

Table H-2 shows the net migration across state lines in terms of the geographic directions and amounts of movement and in terms of state characteristics, rather than in terms of numbers of people moving. It does this for the same three career stages dealt with in Table H-1, and, again, each state is entered twice in terms of changes affecting those who leave (top line) and of those who enter the state (bottom line) at each career transition. It is to be noted that the data of Table H-2 are for those who moved only; it disregards, in calculating average values, those who did not cross state lines at the particular career stage.

Again, it is convenient to use Maine as an example. The first entry under the HS-BA career transition shows that those who left Maine moved southward an average of 290 miles and westward 380 miles, while those who came in at this stage traveled an average of 230 miles north and 150 miles east from their states of high school origin to go to Maine colleges. In doing this, the economic and educational characteristics of the states of residence changed as shown in the next three columns. On the average, those who left Maine moved up the economic scale 131 points, up the higher education scale 161 points, and up the elementary-secondary school scale 84 points in terms of the new environments they encountered. Those who came to Maine from elsewhere to go to college moved down all three scales approximately as far as the "leaver's" moved up, i.e., 161, 158, and 82 points on the E, H, and S scales. At the BA-to-PhD transition, geographic movements were greater: On the average, those who left moved south 340 miles and west 510 miles, while those who came to Maine moved north 350 miles and east 450 miles from their schools of baccalaureate origin. Again, those who left moved up the E, H, and S scales, while those who came to Maine moved down. The story is the same in direction, but different in amount, at the PhD-to-employment transition. In all cases, at each stage and for each state characteristic, a minus (–) sign means that the migrants, whether in-migrants or out-migrants, are moving, on the average, down the scale (i.e., to a state lower on the scale than their state of origin), while a plus (+) sign means that they are moving to a state higher on the given index than their state of origin.

The most obvious thing about this table is that the movements into and out of each state are mostly compensatory or tend to cancel each other out. That is, if the mean movement of the "leavers" is *toward* the south (marked S in Table H-2), then the mean movement of those who come into the state is likely to be *from* the south (marked N in Table H-2, to indicate a northward movement). This is clear from scanning the first NS column, where all but three entries indicate compensating movements. One exception is Ohio, where we find a blank in the out-migration column, indicating a net movement of less than 10 miles in the north-south dimension, together with S10 for in-migration, indicating a minimal southward net in-migration. In Pennsylvania and Utah, both in-migration and out-migration are in the same (southward) direction, but the average net amounts are small, ranging from 10 to 50 miles.

The same compensatory movement rule holds true, in the main, for the east-west geographic direction and also for the indices of economic prosperity, higher education development, and elementary-secondary school strength. It is, however, the exceptions to these general trends that are of greatest interest in the table, as also are imbalances in the strength of in-migration and out-migration. That is, even when they are in compensating directions, the relative strength of movement (average distance moved) in opposite directions is frequently noteworthy. It is important to note in these comparisons that, since the data are mean movement *lengths*, not numbers of people, one person moving from Utah to New York can counterbalance three moving from Utah to California, simply because the latter state is much closer.

Scanning the table quickly, one notes that, in geographic migration at the high school to college stage, the average net movement tends to be southward from the northern

states (i.e., out-migration is south) and northward from the southern states (i.e., net out-migration is north). This is as one would anticipate simply from the constrictions on possible movements. These boundary-effects are less clear with respect to east-west movement, because there is more room to move, particularly for the midwestern states. One notes, too, that the direction of movement at the high school-to-college stage tends to be repeated at the BA-PhD level and again at the PhD-to-job stage, although there are notable exceptions. The strength of this general tendency is worth keeping in mind when studying the high school-to-college movement in such reports as that by Gossman *et al.*,[1] which analyzes student movements in great detail, or the more recent tabulations published by the National Center for Educational Statistics on state-to-state movements at various stages.[2]

One may use the pertinent columns of Tables H-1 and H-2 to test a number of hypotheses about migration of eventual PhD's at each career stage. For example, one might suppose that high school graduates of states high on the elementary-secondary school scale but relatively low on the higher education scale would move up the latter scale for their college educations. To test this, the gain or loss percentage of Table H-1 was correlated with the ratio of the two educational indices of the movers in Table H-2 (S/H, or gains in elementary-secondary school strength divided by gains in higher education development). It is logical to suppose that people who leave their home state to go to college (if they are of eventual PhD caliber) would tend to go to a state with a relatively stronger college system. The correlation of these two variables was found to be 0.48, i.e., high enough to fully sustain the hypothesis, but not high enough to account for a very large proportion of the movement. Other factors, such as distance moved, are also important. Any number of similar hypotheses might be evolved and tested by reference to these tables.

The final line in Table H-2 indicates the net tendency for the United States as a whole when movement across state lines is summed. It might well be supposed that these various movements would cancel out entirely, but this is not quite the case. The geographic movements, while not large, are significant. At the high school-to-college transition and at the BA-to-PhD stages, the net north-south movement is less than 10 miles, as indicated by the blank entries. But the lateral movement is consistently westward at all three stages, 50 to 60 miles per stage, thus tending to parallel (but at a faster clip) the movement of the general population. The U.S. center of population has been moving west-southwestward at about 40 miles per decade since 1940; earlier movements in this century were similar but smaller. At the PhD-to-job transition, there is a net southward movement of about 50 miles. Thus we have confirmation of the long-term migrations described in the first book in this career patterns series.[3] With regard to state indices, the movements are minor except for the HS-BA stage, where there is a net upward movement on the H index of 33 points (one third of a standard deviation). On the economic index, the HS-BA movement is slightly downward (-7 points), up a bit (+21 points) at the BA-PhD stage, and finally down again (-16 points) at the PhD-to-Job stage. This is correlated with the southward migration, of course, but otherwise probably has little significance. In sum, the movement of thousands of people who move across state lines tends, in general, to cancel each other out when the United States as a whole is concerned. The individual movements, on a state-by-state basis where local and regional factors can be assessed, is probably far more important.

[1] C. S. Gossman, C. E. Nobbe, T. J. Patricelli, C. F. Schmid, and T. E. Steahr, *Migration of College and University Students in the United States* (Seattle and London: University of Washington Press, 1968).

[2] National Center for Educational Statistics, *Residence and Migration of College Students* (Washington, D.C.: Government Printing Office, 1970).

[3] Office of Scientific Personnel, NAS-NRC, *Profiles of PhD's in the Sciences* (Washington, D.C.: National Academy of Sciences, 1965). Publication 1293.

TABLE H-1

Migration of 1957–1967 PhD's out of and into Each State at Each Career Stage: Total "Residents," and Numbers and Percentages Moving

	HS-BA			BA-PhD			PhD-Job		
Reference State	Total N	Move N	% of Origin	Total N	Move N	% of Origin	Total N	Move N	% of Origin
Maine									
as Origin	503	−189	−37.6	583	−575	−98.6	25	−19	−76.0
as Destination	583	+269	+53.5	27	+19	+3.3	288	+282	+1,128.0
Net Movement	+80	+80	+15.9	−556	−556	−95.3	+263	+263	+1,052.0
New Hampshire									
as Origin	653	−397	−60.8	750	−738	−98.4	94	−86	−91.5
as Destination	750	+494	+75.7	113	+101	+13.5	325	+317	+337.2
Net Movement	+97	+97	+14.9	−637	−637	−84.9	+231	+231	+245.7
Vermont									
as Origin	277	−143	−51.6	368	−358	−97.3	35	−30	−85.7
as Destination	368	+234	+84.5	41	+31	+8.4	195	+190	+542.9
Net Movement	+91	+91	+32.9	−327	−327	−88.9	+160	+160	+457.2
Massachusetts									
as Origin	4,449	−1,470	−33.0	6,653	−4,111	−61.8	5,896	−3,599	−61.0
as Destination	6,642	+3,663	+82.3	7,390	+4,848	+72.9	4,589	+2,292	+38.9
Net Movement	+2,193	+2,193	+49.3	+737	+737	+11.1	−1,307	−1,307	−22.1
Rhode Island									
as Origin	563	−190	−33.7	710	−638	−89.9	429	−358	−83.4
as Destination	711	+338	+60.0	529	+457	+64.4	407	+336	+78.3
Net Movement	+148	+148	+26.3	−181	−181	−25.5	−22	−22	−5.1
Connecticut									
as Origin	1,886	−1,035	−54.9	1,962	−1,462	−74.5	2,125	−1,606	−75.6
as Destination	1,962	+1,111	+58.9	2,659	+2,159	+110.0	1,739	+1,220	+57.4
Net Movement	+76	+76	+4.0	+697	+697	+35.5	−386	−386	−18.2
New York									
as Origin	16,918	−4,753	−28.1	14,571	−7,713	−52.9	11,316	−5,854	−51.7
as Destination	14,568	+2,403	+14.2	13,673	+6,815	+46.8	9,508	+4,046	+35.8
Net Movement	−2,350	−2,350	−13.9	−898	−898	−6.1	−1,808	−1,808	−15.9
New Jersey									
as Origin	3,976	−2,488	−62.6	2,304	−1,797	−78.0	2,040	−1,364	−66.9
as Destination	2,302	+814	+20.5	2,526	+2,019	+87.6	3,518	+2,842	+139.3
Net Movement	−1,674	−1,674	−42.1	+222	+222	+9.6	+1,478	+1,478	+72.4
Pennsylvania									
as Origin	7,492	−2,115	−28.2	7,265	−4,357	−60.0	4,902	−2,711	−55.3
as Destination	7,262	+1,885	+25.2	6,051	+3,143	+43.3	4,876	+2,685	+54.8
Net Movement	−230	−230	−3.0	−1,214	−1,214	−16.7	−26	−26	−0.5
Ohio									
as Origin	5,389	−1,424	−26.4	5,773	−3,822	−66.2	3,431	−1,988	−57.9
as Destination	5,774	+1,809	+33.6	4,360	+2,409	+41.7	3,858	+2,415	+70.4
Net Movement	+385	+385	+7.2	−1,413	−1,413	−24.5	+427	+427	+12.5
Indiana									
as Origin	2,687	−698	−26.0	3,530	−2,245	−63.6	4,231	−3,322	−78.5
as Destination	3,525	+1,536	+57.2	5,094	+3,809	+107.9	2,317	+1,408	+33.3
Net Movement	+838	+838	+31.2	+1,564	+1,564	+44.3	−1,914	−1,914	−45.2
Illinois									
as Origin	7,304	−2,535	−34.7	6,631	−4,000	−60.3	6,299	−4,427	−70.3
as Destination	6,625	+1,856	+25.4	7,808	+5,177	+78.1	4,540	+2,668	+42.4
Net Movement	−679	−679	−9.3	+1,177	+1,177	+17.8	−1,759	−1,759	−27.9
Michigan									
as Origin	3,961	−738	−18.6	4,428	−2,300	−51.9	4,546	−2,927	−64.4
as Destination	4,426	+1,203	+30.4	5,868	+3,740	+84.5	3,421	+1,802	+39.6
Net Movement	+465	+465	+11.8	+1,440	+1,440	+32.6	−1,125	−1,125	−24.8

TABLE H-1

Migration of 1957-1967 PhD's out of and into Each State at Each Career Stage: Total "Residents," and Numbers and Percentages Moving—Continued

	HS-BA			BA-PhD			PhD-Job		
Reference State	Total N	Move N	% of Origin	Total N	Move N	% of Origin	Total N	Move N	% of Origin
Wisconsin									
as Origin	2,947	−820	−27.8	2,723	−1,694	−62.2	2,869	−2,225	−77.6
as Destination	2,718	+591	+20.1	3,788	+2,759	+101.3	2,077	+1,433	+49.9
Net Movement	−229	−229	−7.7	+1,065	+1,065	+39.1	−792	−792	−27.7
Minnesota									
as Origin	2,646	−582	−22.0	2,810	−1,814	−64.6	1,798	−1,224	−68.1
as Destination	2,810	+746	+28.2	2,363	+1,367	+48.6	1,581	+1,007	+56.0
Net Movement	+164	+164	+6.2	−447	−447	−16.0	−217	−217	−12.1
Iowa									
as Origin	2,388	−584	−24.5	2,549	−1,615	−63.4	2,566	−2,017	−78.6
as Destination	2,544	+740	+31.0	3,192	+2,258	+88.6	1,290	+741	+28.9
Net Movement	+156	+156	+6.5	+643	+643	+25.5	−1,276	−1,276	−49.7
Missouri									
as Origin	2,861	−930	−32.5	2,648	−1,774	−67.0	1,666	−1,091	−65.5
as Destination	2,642	+711	+24.9	2,100	+1,226	+46.3	1,745	+1,170	+70.2
Net Movement	−219	−219	−7.6	−548	−548	−20.7	+79	+79	+4.7
North Dakota									
as Origin	538	−228	−42.4	372	−303	−81.5	147	−113	−76.9
as Destination	372	+62	+11.5	179	+110	+29.6	217	+183	+124.5
Net Movement	−166	−166	−30.9	−193	−193	−51.9	+70	+70	+47.6
South Dakota									
as Origin	637	−225	−35.3	514	−481	−93.6	78	−61	−78.2
as Destination	515	+103	+16.2	86	+53	+10.3	278	+261	+334.6
Net Movement	−122	−122	−19.1	−428	−428	−83.3	+200	+200	+256.4
Nebraska									
as Origin	1,460	−402	−27.5	1,297	−851	−65.6	692	−435	−62.9
as Destination	1,296	+238	+16.3	835	+389	+30.0	656	+399	+57.7
Net Movement	−164	−164	−11.2	−462	−462	−35.6	−36	−36	−5.2
Kansas									
as Origin	1,958	−438	−22.4	1,929	−1,461	−75.7	929	−709	−76.3
as Destination	1,928	+408	+20.8	1,217	+749	+38.8	1,120	+900	+96.9
Net Movement	−30	−30	−1.6	−712	−712	−36.9	+191	+191	+20.6
Delaware									
as Origin	242	−138	−57.0	156	−141	−90.4	208	−160	−76.9
as Destination	157	+53	+21.9	250	+235	+150.6	770	+722	+347.1
Net Movement	−85	−85	−35.1	+94	+94	+60.2	+562	+562	+270.2
Maryland									
as Origin	1,312	−569	−43.4	1,477	−1,042	−70.5	1,636	−1,072	−65.5
as Destination	1,473	+730	+55.6	2,004	+1,569	+106.2	2,243	+1,679	+102.6
Net Movement	+161	+161	+12.2	+527	+527	+35.7	+607	+607	+37.1
District of Columbia									
as Origin	737	−496	−67.3	821	−504	−61.4	1,520	−1,008	−66.3
as Destination	820	+579	+78.6	1,894	+1,577	+192.1	2,170	+1,658	+109.1
Net Movement	+83	+83	+11.3	+1,073	+1,073	+130.7	+650	+650	+42.8
Virginia									
as Origin	1,545	−635	−41.2	1,388	−1,074	−77.4	752	−531	−70.6
as Destination	1,387	+481	+31.2	912	+598	+43.1	1,355	+1,134	+150.8
Net Movement	−154	−154	−10.0	−476	−476	−34.3	+603	+603	+80.2
West Virginia									
as Origin	853	−306	−35.9	707	−616	−87.1	136	−93	−68.4
as Destination	708	+161	+18.9	172	+81	+11.5	392	+349	+256.6
Net Movement	−145	−145	−17.0	−535	−535	−75.6	+256	+256	+188.2

TABLE H-1

Migration of 1957-1967 PhD's out of and into Each State at Each Career Stage: Total "Residents," and Numbers and Percentages Moving—Continued

Reference State	HS-BA			BA-PhD			PhD-Job		
	Total N	Move N	% of Origin	Total N	Move N	% of Origin	Total N	Move N	% of Origin
North Carolina									
as Origin	1,470	−291	−19.8	1,845	−1,195	−64.8	1,969	−1,376	−69.9
as Destination	1,846	+667	+45.4	2,518	+1,868	+101.2	1,700	+1,107	+56.2
Net Movement	+376	+376	+25.6	+673	+673	+36.4	−269	−269	−13.7
South Carolina									
as Origin	679	−198	−29.2	689	−616	−89.4	147	−95	−64.6
as Destination	690	+209	+30.8	169	+96	+13.9	540	+488	+332.0
Net Movement	+11	+11	+1.6	−520	−520	−75.5	+393	+393	+267.4
Georgia									
as Origin	1,258	−364	−28.9	1,285	−920	−71.6	743	−459	−61.8
as Destination	1,286	+392	+31.2	853	+488	+38.0	1,177	+893	+120.2
Net Movement	+28	+28	+2.3	−432	−432	−33.6	+434	+434	+58.4
Florida									
as Origin	1,463	−584	−39.9	1,275	−786	−61.6	1,546	−1,034	−66.9
as Destination	1,276	+397	+27.1	1,967	+1,478	+115.9	1,517	+1,005	+65.0
Net Movement	−187	−187	−12.8	+692	+692	+54.3	−29	−29	−1.9
Kentucky									
as Origin	1,250	−365	−29.2	1,197	−954	−79.7	429	−269	−62.7
as Destination	1,196	+311	+24.9	504	+261	+21.8	812	+652	+152.0
Net Movement	−54	−54	−4.3	−693	−693	−57.9	+383	+383	+89.3
Tennessee									
as Origin	1,440	−446	−31.0	1,594	−1,125	−70.6	1,221	−800	−65.5
as Destination	1,594	+600	+41.7	1,549	+1,080	+67.8	1,475	+1,054	+86.3
Net Movement	+154	+154	+10.7	−45	−45	−2.8	+254	+254	+20.8
Alabama									
as Origin	1,156	−314	−27.2	1,155	−848	−73.4	493	−293	−59.4
as Destination	1,154	+312	+27.0	603	+296	+25.6	785	+585	+118.7
Net Movement	−2	−2	−0.2	−552	−552	−47.8	+292	+292	+59.3
Mississippi									
as Origin	774	−215	−27.8	648	−518	−79.9	263	−162	−61.6
as Destination	648	+89	+11.5	310	+180	+27.8	488	+387	+147.1
Net Movement	−126	−126	−16.3	−338	−338	−52.1	+225	+225	+85.5
Arkansas									
as Origin	966	−308	−31.9	799	−603	−75.5	344	−258	−75.0
as Destination	800	+142	+14.7	408	+212	+26.5	410	+324	+94.2
Net Movement	−166	−166	−17.2	−391	−391	−49.0	+66	+66	+19.2
Louisiana									
as Origin	1,203	−213	−17.7	1,288	−862	−66.9	951	−596	−62.7
as Destination	1,288	+298	+24.8	1,204	+778	+60.4	1,231	+876	+92.1
Net Movement	+85	+85	+7.1	−84	−84	−6.5	+280	+280	+29.4
Oklahoma									
as Origin	1,807	−393	−21.7	1,811	−1,073	−59.2	1,281	−837	−65.3
as Destination	1,810	+396	+21.9	1,624	+886	+48.9	1,070	+626	+48.9
Net Movement	+3	+3	+0.2	−187	−187	−10.3	−211	−211	−16.4
Texas									
as Origin	4,342	−641	−14.8	4,376	−2,195	−50.2	2,886	−1,400	−48.5
as Destination	4,373	+672	+15.5	3,784	+1,603	+36.6	3,603	+2,117	+73.4
Net Movement	+31	+31	+0.7	−592	−592	−13.6	+717	+717	+24.9
Montana									
as Origin	521	−178	−34.2	421	−360	−85.5	140	−102	−72.9
as Destination	420	+77	+14.8	159	+98	+23.3	276	+238	+170.0
Net Movement	−101	−101	−19.4	−262	−262	−62.2	+136	+136	+97.1

TABLE H-1

Migration of 1957-1967 PhD's out of and into Each State at Each Career Stage: Total "Residents," and Numbers and Percentages Moving—Continued

Reference State	HS-BA			BA-PhD			PhD-Job		
	Total N	Move N	% of Origin	Total N	Move N	% of Origin	Total N	Move N	% of Origin
Idaho									
as Origin	662	−369	−55.7	398	−381	−95.7	41	−36	−87.8
as Destination	399	+106	+16.0	56	+39	+9.8	283	+278	+678.0
Net Movement	−263	−263	−39.7	−342	−342	−85.9	+242	+242	+590.2
Wyoming									
as Origin	272	−136	−50.0	175	−144	−82.3	205	−146	−71.2
as Destination	175	+39	+14.3	243	+212	+121.1	183	+124	+60.5
Net Movement	−97	−97	−35.7	+68	+68	+38.8	−22	−22	−10.7
Colorado									
as Origin	1,204	−338	−28.1	1,540	−1,117	−72.5	1,735	−1,269	−73.1
as Destination	1,540	+674	+56.0	2,169	+1,746	+113.4	1,494	+1,028	+59.3
Net Movement	+336	+336	+27.9	+629	+629	+40.9	−241	−241	−13.8
New Mexico									
as Origin	377	−145	−38.5	413	−342	−82.8	278	−162	−58.3
as Destination	412	+180	+47.7	353	+282	+68.3	840	+724	+260.4
Net Movement	+35	+35	+9.2	−60	−60	−14.5	+562	+562	+202.1
Arizona									
as Origin	449	−187	−41.6	476	−339	−71.2	578	−402	−69.6
as Destination	476	+214	+47.7	766	+629	+132.1	747	+571	+98.8
Net Movement	+27	+27	+6.1	+290	+290	+60.9	+169	+169	+29.2
Utah									
as Origin	1,336	−115	−8.6	1,771	−1,183	−66.8	657	−412	−62.7
as Destination	1,766	+545	+40.8	938	+350	+19.8	697	+452	+68.8
Net Movement	+430	+430	+32.2	−833	−833	−47.0	+40	+40	+6.1
Nevada									
as Origin	126	−65	−51.6	87	−86	−98.9	8	−7	−87.5
as Destination	89	+28	+22.2	8	+7	+8.0	144	+143	+1,787.5
Net Movement	−37	−37	−29.4	−79	−79	−90.9	+136	+136	+1,700.0
Washington									
as Origin	1,779	−469	−26.4	1,722	−1,161	−67.4	1,426	−986	−69.1
as Destination	1,715	+405	+22.8	1,782	+1,221	+70.9	1,559	+1,119	+78.5
Net Movement	−64	−64	−3.6	+60	+60	+3.5	+133	+133	+9.4
Oregon									
as Origin	1,144	−301	−26.3	1,302	−989	−76.0	1,048	−735	−70.1
as Destination	1,295	+452	+39.5	1,305	+992	+76.2	1,006	+693	+66.1
Net Movement	+151	+151	+13.2	+3	+3	+0.2	−42	−42	−4.0
California									
as Origin	6,873	−1,046	−15.2	7,642	−3,104	−40.6	8,768	−3,693	−42.1
as Destination	7,613	+1,786	+26.0	10,425	+5,887	+77.0	10,011	+4,936	+56.3
Net Movement	+740	+740	+10.8	+2,783	+2,783	+36.4	+1,243	+1,243	+14.2

TABLE H-2

Directions and Mean Amounts of Movement on Five Indices of Those Moving across State Lines at Each Career Stage

	HS-BA					BA-PhD					PhD-Job				
State	NS	EW	Econ	HiEd	Elem Sec	NS	EW	Econ	HiEd	Elem Sec	NS	EW	Econ	HiEd	Elem Sec
Maine															
Out	S 290	W380	+131	+161	+84	S 340	W510	+135	+125	+92	S 420	W360	+101	+90	+47
In	N230	E 150	−161	−158	−82	N350	E 450	−133	−70	−74	N320	E 530	−134	−126	−93
New Hampshire															
Out	S 140	W190	+74	+9	+64	S 230	W550	+64	−37	+81	S 260	W480	+30	−64	+55
In	N160	E 290	−72	+36	−68	N160	E 210	−43	+15	−46	N210	E 510	−70	+22	−86
Vermont															
Out	S 200	W270	+102	−124	+43	S 280	W380	+123	−151	+65	S 280	W440	+124	−167	+61
In	N170	E 30	−154	+149	−64	N290	E 250	−112	+196	−41	N240	E 330	−134	+155	−66
Massachusetts															
Out	S 140	W400	−25	−207	−2	S 220	W730	−6	−205	+33	S 250	W810	−24	−194	+22
In	N170	E 450	+11	+221	−9	N220	E 670	+33	+216	−11	N220	E 760	+10	+206	−32
Rhode Island															
Out	S 80	W320	+14	+67	+58	S 130	W550	+21	+28	+73	S 170	W610	+6	+18	+66
In	N 50	E 200	−41	−38	−62	N120	E 450	−4	−21	−58	N120	E 470	−22	−22	−69
Connecticut															
Out	S 50	W240	−110	+80	−22	S 120	W560	−106	+59	+3	S 160	W580	−121	+55	−16
In	N 90	E 360	+111	−43	+22	N110	E 420	+120	−47	+21	N110	E 540	+101	−55	−6
New York															
Out	S 100	W340	−70	+50	−68	S 140	W540	−63	+42	−50	S 170	W540	−73	+9	−64
In	N110	E 250	+55	+8	+79	N130	E 500	+89	−23	+73	N130	E 580	+64	−34	+48
New Jersey															
Out	S 20	W250	−74	+145	+19	S 50	W430	−60	+159	+45	S 100	W530	−84	+156	+27
In	N 40	E 260	+67	−137	−23	N 30	E 370	+77	−152	−28	N 30	E 410	+57	−145	−48
Pennsylvania															
Out	S 30	W190	+21	+66	+37	S 30	W330	+31	+70	+59	S 80	W370	+15	+44	+45
In	S 10	E 40	−53	−15	−46	N 30	E 290	−10	−54	−42	N 20	E 340	−29	−65	−59
Ohio															
Out		W110	−8	+110	+42	S 10	W200	−5	+103	+54	S 90	W280	−37	+80	+30
In	S 10	W 60	+6	−70	−23	N 50	E 160	+41	−82	−18		E 190	+11	−99	−46
Indiana															
Out	N 20	W 10		−30	−42	N 30	W100	+5	−20	−20	S 30	W140	−24	−34	−41
In	S 50	W 70	−14	+53	+43	S 20	E 60	+25	+31	+47	S 40	E 100		+19	+25
Illinois															
Out	S 20	W 50	−106	+25	+4	S 30	W 70	−97	+27	+13	S 80	W 70	−106	+11	−3
In	N 10	W 60	+101	+1	+8	N 30	W 30	+113	−9	+15	N 20	E 30	+97	−27	−9
Michigan															
Out	S 140	W190	−19	+17	−47	S 150	W280	−20	+22	−34	S 200	W280	−41	+8	−52
In	N110	W 70	+3	+12	+55	N150	E 140	+41	−4	+62	N130	E 210	+22	−13	+43
Wisconsin															
Out	S 140		+15	+45	−19	S 180	W 60	+16	+42	−12	S 220	W 50	−3	+21	−33
In	N130	W170	−53	−16	+21	N180	W 60	+2	−20	+39	N190	E 50	−14	−41	+16
Minnesota															
Out	S 240	E 100	+41	−7	−46	S 270	E 110	+60	−16	−31	S 320	E 130	+49	−33	−49
In	N160	W 50	−26	+33	+57	N250	W190	−48	+31	+50	N260	W180	−62	+15	+34
Iowa															
Out	S 40	W 30	+29	−53	−4	S 70	E 100	+41	−46	+4	S 130	E 50	+21	−71	−15
In	N 10	W140	−53	+63	+12	N 70	W120	−19	+67	+22	N 60	W140	−41	+53	+5
Missouri															
Out	N110	E 90	+14	+76	+83	N110	E 50	+24	+72	+97	N 80	E 30	+6	+50	+80
In	S 140	W 80	−32	−55	−87	S 120	W 70	−6	−54	−77	S 90	W 80	−11	−66	−87
North Dakota															
Out	S 260	E 190	+126	+5	+72	S 390	E 250	+139	−8	+66	S 370	E 230	+123	−17	+60
In	N230	W200	−121	−9	−85	N290	W270	−116	+1	−61	N440	W380	−130	+11	−43

TABLE H-2

Directions and Mean Amounts of Movement on Five Indices of Those Moving across State Lines at Each Career Stage—Continued

	HS-BA					BA-PhD					PhD-Job				
State	NS	EW	Econ	HiEd	Elem Sec	NS	EW	Econ	HiEd	Elem Sec	NS	EW	Econ	HiEd	Elem Sec
South Dakota															
Out	S 110	E 130	+120	−24	+97	S 210	E 290	+125	−31	+79	S 220	E 280	+98	−47	+52
In	N 80	W190	−106	+24	−83	N150	W210	−92	+26	−67	N190	W210	−118	+30	−85
Nebraska															
Out	S 10	E 90	+39	+26	+67	S 20	E 190	+44	+7	+65	S 50	E 220	+30	−10	+45
In	N 30	W150	−12	−7	−39	N 30	W190	−26	−2	−39	N 50	W230	−36	−4	−51
Kansas															
Out	N 70	E 100	+26	−6	−14	N130	E 200	+43	−8	−3	N 60	E 270	+26	−38	−34
In	S 70	W170	−22	+42	+50	S 110	W300	−26	+32	+36	S 110	W220	−32	+11	+13
Delaware															
Out	N 50	W180	−82	+144	−87	N 20	W440	−77	+148	−71	N 20	W300	−83	+119	−90
In	S 80	E 70	+51	−90	+86		E 260	+102	−113	+102	S 10	E 560	+88	−140	+66
Maryland															
Out	N 30	W200	+17	+22	−10	N 10	W400	+38	+42	+21	S 20	W430	+28	+50	+5
In	S 10	E 290	−38	−38	+2	S 40	E 360	−13	−2	−4	S 20	E 440	−38	−61	−19
D.C.															
Out	N 80	W160	−154	−417	+24	N 60	W360	−146	−425	+45	N 40	W340	−170	−432	+28
In	S 50	E 230	+162	+444	−20	S 80	E 330	+156	+429	−35	S 80	E 400	+145	+411	−49
Virginia															
Out	N 60	W220	+88	+99	+48	N 70	W280	+95	+83	+70	S 20	W330	+68	+60	+41
In	S 60	E 160	−87	−54	−45	S 30	E 290	−61	−61	−34	S 90	E 330	−105	−97	−78
West Virginia															
Out	N 30	W100	+115	+78	+114	N 50	W170	+135	+103	+146	S 10	W 50	+111	+88	+120
In	S 130	W 90	−160	−88	−142	S 70	E 20	−114	−68	−120	S 90	E 190	−139	−93	−151
North Carolina															
Out	N 80	W260	+61	−33	+50	N210	W320	+127	−16	+135	N120	W400	+82	−28	+98
In	S 90	E 90	−71	+58	−69	S 150	E 320	−80	+33	−90	S 190	E 390	−116	+20	−131
South Carolina															
Out	N170	W120	+86	+72	+116	N180	W150	+98	+64	+149	N130	W250	+80	+62	+124
In	S 170	E 140	−93	−63	−139	S 150	E 160	−71	−60	−114	S 180	E 200	−101	−66	−155
Georgia															
Out	N210	W 70	+40	+58	+76	N320	W 70	+90	+78	+130	N230	W200	+51	+57	+91
In	S 120		−28	−31	−74	S 270	E 100	−43	−55	−77	S 310	E 90	−86	−67	−131
Florida															
Out	N610	W270	+96	+107	−29	N710	W370	+135	+120	+25	N590	W410	+95	+102	−19
In	S 770	E 160	−153	−95	−15	S 670	E 320	−108	−98	+10	S 760	E 390	−146	−120	−36
Kentucky															
Out	N 70	E 40	+116	+80	+126	N 70	W 60	+127	+84	+158	N 40	W 60	+105	+74	+129
In	S 70	W110	−104	−54	−113	S 50	E 60	−97	−72	−126	S 80	E 120	−129	−83	−157
Tennessee															
Out	N130	E 60	+91	+17	+119	N160	W 20	+110	+16	+153	N 70	W 30	+75	+3	+116
In	S 30	W 50	−46	+23	−78	S 90	E 20	−69	−1	−104	S 180	E 40	−113	−18	−154
Alabama															
Out	N250	E 40	+91	+62	+87	N350	E 20	+139	+65	+152	N120	W 10	+53	+35	+60
In	S230	W110	−103	−26	−113	S 190	E 30	−66	−37	−79	S 320	E 10	−125	−48	−148
Mississippi															
Out	N140	E 20	+111	+4	+126	N250	E 60	+151	+14	+167	N120	E 80	+99	−6	+111
In	S 310	W150	−156	+9	−133	S 200	W 70	−111	+4	−110	S 240	W110	−151	−4	−165
Arkansas															
Out	N 40	E 10	+103	+33	+141	N160	E 70	+130	+39	+168	N 70	W 90	+98	+32	+151
In	S 180	E 80	−132	−27	−163	S 70		−103	−38	−147	S 160	W 30	−128	−44	−171

TABLE H-2

Directions and Mean Amounts of Movement on Five Indices of Those Moving across State Lines at Each Career Stage--Continued

	HS-BA					BA-PhD					PhD-Job				
State	NS	EW	Econ	HiEd	Elem Sec	NS	EW	Econ	HiEd	Elem Sec	NS	EW	Econ	HiEd	Elem Sec
Louisiana															
Out	N440	E 40	+123	+4	+77	N480	E 50	+123	+1	+87	N440	E 50	+101	-9	+56
In	S360	W170	-69	+30	-11	S420	W100	-90	+24	-43	S490	W110	-117		-76
Oklahoma															
Out	N160	E 150	+98	-11	+45	N230	E 210	+105	-13	+58	N 90	E 180	+58	-30	+14
In	S130	W250	-74	+33	-15	S160	W230	-68	+22	-22	S240	W280	-107	+16	-52
Texas															
Out	N520	E 320	+63	+80	+61	N580	E 370	+81	+79	+76	N500	E 300	+48	+65	+49
In	S460	W340	-30	-55	-28	S510	W410	-44	-59	-36	S580	W370	-74	-70	-69
Montana															
Out	S250	E 180	+68	+57	+44	S370	E 560	+74	+33	+17	S420	E 510	+50	+31	+1
In	N350	W590	-65	-7	+1	N360	W660	-38	-25	+14	N390	W560	-71	-40	-19
Idaho															
Out	S200	E 170	+50	+199	+151	S220	E 600	+113	+92	+119	S180	E 380	+109	+63	+116
In	N130	W640	-104	-68	-102	N240	W590	-99	-92	-106	N220	W600	-101	-94	-118
Wyoming															
Out	S160	E 240	+16	+97	-16	S130	E 430	+58	+43	-25	S140	E 330	+8	+30	-54
In	N 60	W570	-31	-46	+68	N130	W450	-17	-39	+56	N180	W490	-31	-57	+37
Colorado															
Out	N 70	E 490	+66	-71	-68	N 70	E 510	+70	-77	-62	N 40	E 450	+35	-89	-85
In	S 70	W640	-53	+100	+92	S 60	W580	-87	+88	+93	S 80	W580	-66	+80	+70
New Mexico															
Out	N190	E 270	+161	+48	-33	N300	E 520	+176	+48	-33	N320	E 540	+170	+31	-49
In	S270	W750	-180	-25	+64	S290	W680	-170	-32	+62	S340	W620	-189	-43	+37
Arizona															
Out	N350	E 380	+139	+90	+26	N400	E850	+163	+49	-7	N360	E 690	+136	+36	-18
In	S460	W1010	-169	-29	+28	S440	W940	-139	-37	+32	S430	W910	-155	-39	+21
Utah															
Out	S 50	E 380	+123	-212	-42	S 10	E 780	+138	-229	-61	S 60	E 590	+108	-244	-75
In	S 30	W170	-72	+269	+91	N 20	W670	-102	+243	+84	N 20	W730	-136	+222	+58
Nevada															
Out	N 20	E 340	-62	+249	+39	N 50	E 630	-33	+180	+12		E 730	-79	+151	-33
In	S 10	W350	+20	-178	-37	N 60	W620	+2	-166	-49	S 30	W860	+45	-167	+16
Washington															
Out	S490	E 760	-1	+36	-28	S560	E 1070	+12	+31	-35	S620	E 980	-11	+19	-47
In	N470	W720	+35	-14	+54	N560	W950	+16	-27	+46	N570	W1130	-1	-27	+46
Oregon															
Out	S370	E 730	+31	+36	-29	S390	E 1150	+45	+10	-47	S420	E 960	+20	+12	-52
In	N290	W610	-25	-3	+35	N370	W890	-8	-17	+54	N400	W1130	-39	-8	+50
California															
Out	N310	E1330	-54	-13	-139	N310	E1620	-28	-24	-144	N250	E 1660	-38	-35	-157
In	S260	W1490	+51	+51	+153	S270	W1670	+39	+34	+156	S290	W1750	+22	+30	+150
Total															
Out		**W 60**	**-7**	**+33**	**+5**		**W 50**	**+21**	**+15**	**+22**	**S 50**	**W 60**	**-16**	**-12**	**-13**
In		**W 60**	**-7**	**+33**	**+5**		**W 50**	**+21**	**+15**	**+22**	**S 50**	**W 60**	**-16**	**-12**	**-13**

APPENDIX I Personal Characteristics of Migration Streams

People in the various international migration streams vary to some extent in their personal characteristics: age, sex ratio, marital status, and number of dependents. The following paragraphs will sketch some of the significant features of each of these groups.

The "All-American" group is a good reference point because it comprises the bulk of the U.S. PhD population. On the average, these people are 33 1/3 years old at the time of the PhD, 79 percent are married, and 89 percent are men and 11 percent women. On the average, they have 2.1 dependents. But these characteristics vary enormously by field of PhD as shown by Table I-1.

The engineering-math-physical science field group is clearly the youngest, with more than half under 30 on receipt of the PhD. It also includes almost no women. The humanities-arts-professions group is in strong contrast: It is the oldest, has an average age of 37, and is 17 percent female. The other statistics tend to follow rather regularly from these basic facts of age and sex: i.e., the percent married, number of dependents, and years of predoctoral professional experience are all related to age, and the fields vary systematically in these statistics as they do in age. There is one significant point to note, however: A majority of women in all fields are single, whereas a majority of men are married—even those men in their 20's who have fewest dependents (not shown in Table I-1). Only in the youngest age group is the majority of women married. The evidence here supports the popular belief that a great many women have had to make a choice (perhaps not entirely a voluntary one) between attainment of a doctoral degree and marriage. With men, the married percentage climbs steadily with age; with women, the opposite is true. For women, the married proportion drops from over half in their 20's to a plateau of about one third thereafter. The percentages vary somewhat by field, but the pattern is much the same. It should be noted here that "single" in these statistics includes the divorced and widowed; this helps to explain, for the oldest age group, why the single group is as large as it is, for both men and women.

The various field groups differ significantly with respect to the age-sex-marital status relationship. For example, the percentage of women as a function of age at PhD, for all fields combined, maintains a plateau until age 40 and then suddenly dramatically rises. When the various fields are taken individually, however, each field shows a drop in percentage of women during the 30's, followed by a doubling of the percentage of women among PhD's of 40 and over. This is shown in Table I-2, where the absolute numbers of men and women and the percentage married and single is shown for each age bracket and field group.

Do the demographic features of the All-American group characterize the other origin/destination groups? The answer is "yes" for some of the characteristics, and "no" for others. The sex ratios vary in the same way from field to field, as shown in Table I-3 for the seven origin/destination groups. The percentages differ somewhat, but the same pattern prevails: In percentage of women, E-M-P < Bio-Soc Sci < H-A-P.

The foreign origins groups tend to have a somewhat higher proportion of women, but this is not entirely uniform. Among people of U.S. origin going abroad after the PhD, there is a higher percentage of women than among those in the same fields who stay at home. An analagous pattern prevails with the foreign citizen groups: The percentage of women is larger among those who remain abroad than among those who return home. This would suggest that among PhD's, it is the female of the species that is the more adventurous. The foreign-born U.S. citizen group has an unusually large percentage of women, which may be related in part to the fact that this is an older group than that composed of native-born citizens, and women are relatively more numerous among the over-40 PhD's. It is interesting, in this connection, to note that among both the men and the women of this group the sciences (and particularly the E-M-P fields) receive greater emphasis than among the All-American PhD's.

Table I-4 compares the seven origin/destination groups with respect to age, by sex, for each of the three field groups. Some elements in the age pattern are constant across all three field groups: (1) The youngest are the American citizens going abroad (AAF) in the case of both men and women. (2) The foreign-born U.S. citizens mentioned above (FAA) are the oldest for both men and women. (3) Among foreign citizens, the oldest are those planning to stay in the United States; the youngest are those least certain about their postdoctoral plans. (4) In all groups, both male and female, the age hierarchy is the same: The E-M-P group is youngest, the H-A-P group is the oldest. This field differential is greater for women than for men in almost all groups, although the small numbers of cases make some comparisons tenuous.

In the E-M-P fields, the U.S. groups are younger than the foreign citizen groups. This differential is less in the bio-social sciences and absent or even reversed in the H-A-P fields. For the Americans, the dominant age group is the 20's in the science fields and the 30's in the H-A-P. For the foreign citizens the dominant group is the 30's in all fields. The age difference between Americans and foreigners, by field, is considerably less for women than for men. The Americans are younger only in the E-M-P fields; in the H-A-P field, the foreign PhD's—both men and women—are younger than the Americans. For the foreigners the maximum percentage of over-40 women is found among those women returning home, while for the Americans the minimum percentage for the over-40 group is found for those going abroad. This pattern holds for all three field groups.

TABLE I-1

Age, Sex, Marital Status, Number of Dependents, and Years of Predoctoral Professional Experience 1960–1967 PhD's of U.S. Origin and Destination, by Field

Characteristic	Tot. All Fields		E-M-P		Bio-Soc. Sci.		H-A-P	
	N[a]	%	N[a]	%	N[a]	%	N[a]	%
Age								
Mean	33.3	–	30.1	–	32.6	–	37.0	–
Under 30	24,755	35	11,736	58	9,450	37	3,569	14
30–39	34,476	48	7,695	38	12,987	51	13,794	54
40 and over	12,249	17	969	5	3,295	13	7,985	32
Sex								
Men	63,892	89	19,980	98	22,784	89	21,128	83
Women	7,588	11	420	2	2,948	11	4,220	17
Marital status								
Men: married	53,714	84	16,159	81	19,229	84	18,326	87
single	10,178	16	3,821	19	3,555	16	2,802	13
Women: married	3,000	40	194	46	1,363	46	1,443	34
single	4,588	60	226	54	1,585	54	2,777	66
Number of dependents								
Mean number	2.1	–	2.0	–	2.0	–	2.3	–
2 or fewer	43,685	61	13,174	65	16,287	63	14,224	56
More than 2	27,795	39	7,226	35	9,445	37	11,124	44
Predoctoral professional experience								
Mean no. of years	6.6	–	4.2	–	5.2	–	10.2	–
0–1 yr	12,323	17	6,115	30	5,100	20	1,108	4
2–4 yr	20,900	29	7,120	35	9,460	37	4,320	17
Over 4 yr	38,257	54	7,165	35	11,172	43	19,920	79

[a]Or mean.

TABLE I-2

Married and Single PhD's, by Sex and Field Group, 1960-1967 PhD's in "All-American" Category

Field	Age		Men and Women			Men		Women		Women as % of Age Total
			Total	Married	Single	Married	Single	Married	Single	
Total	20-29	N	24,755	18,667	6,088	17,737	5,268	930	820	
		%	100	75	25	77	23	53	47	7
	30-39	N	34,476	28,495	5,981	27,456	4,070	1,039	1,911	
		%	100	83	17	87	13	35	65	8
	40 & up	N	12,249	9,091	2,554	8,521	840	1,031	1,857	
		%	100	78	22	91	9	36	64	23
E-M-P	20-29	N	11,736	8,780	2,956	8,643	2,834	137	122	
		%	100	75	25	75	25	53	47	2.2
	30-39	N	7,695	6,695	1,000	6,649	926	46	74	
		%	100	87	13	88	12	38	62	1.6
	40 & up	N	969	878	91	867	61	11	30	
		%	100	91	9	93	7	27	73	4.2
Bio-Soc. Sci.	20-29	N	9,450	7,292	2,158	6,719	1,717	573	441	
		%	100	77	23	80	20	57	43	10.7
	30-39	N	12,987	10,722	2,265	10,245	1,581	477	684	
		%	100	83	17	87	13	41	59	8.9
	40 & up	N	2,938	2,578	717	2,265	257	313	460	
		%	100	78	22	90	10	40	60	23.5
H-A-P	20-29	N	3,569	2,595	974	2,375	717	220	257	
		%	100	73	27	77	23	46	54	13.4
	30-39	N	13,794	11,078	2,716	10,562	1,563	516	1,153	
		%	100	80	20	87	13	31	69	12.1
	40 & up	N	7,985	6,096	1,889	5,389	522	707	1,367	
		%	100	76	24	91	9	34	66	26.0

TABLE I-3

Percentage of Women among 1960-1967 U.S. PhD's by Field and Origin/Destination Group

Origin/Destination Groups			Field Groups			
Origin[a]	Citizenship	Destination	Total All Fields	E-M-P	Bio-Soc. Sci.	H-A-P
USA	USA	USA	11	2	11	17
USA	USA	Foreign	16	3	17	27
USA	USA	Unknown	9	3	11	14
Foreign	USA	USA	16	4	18	26
Foreign	Foreign	USA	9	4	12	21
Foreign	Foreign	Foreign	9	3	7	20
Foreign	Foreign	Unknown	13	5	14	33

[a]Origin refers to place of birth; thus the fourth group is foreign-born U.S. citizens, almost all of whom remained in the United States following PhD graduation.

TABLE I-4

Percentage Age Distribution of 1960–1967 U.S. PhD's, by Field, Sex, and Origin/Destination Groups[a]

Origin	Citizen. Dest.		E-M-P			Bio-Soc. Sci.			H-A-P		
			20–29	30–39	≥40	20–29	30–39	≥40	20–29	30–39	≥40
Males											
A	A	A	57	38	5	37	52	11	15	57	28
A	A	F	79	20	1	50	44	7	24	57	29
A	A	?	63	34	4	39	49	12	13	54	23
F	A	A	41	48	11	23	55	21	9	49	42
F	F	A	45	51	4	33	59	8	22	60	18
F	F	F	43	53	5	28	61	11	18	60	22
F	F	?	39	56	5	27	63	10	16	58	26
Females											
A	A	A	62	29	10	34	39	26	11	40	49
A	A	F	73	27	0	61	29	11	19	46	35
A	A	?	66	31	3	32	44	24	13	37	50
F	A	A	52	40	9	25	42	33	11	37	52
F	F	A	56	42	2	43	48	9	19	53	28
F	F	F	54	40	6	34	53	14	16	49	35
F	F	?	55	44	1	31	57	12	33	41	26

[a]A = United States, F = foreign, ? = unknown.

APPENDIX J A Note on Cumulative Inertia

"Cumulative inertia," used to describe the probability of moving in terms of the previous moves an individual has made, is a term employed by Dr. Robert McGinnis of Cornell in his mathematical model of this concept. Briefly put, the more one moves, the more likely he is to move; the longer he stays in one place, the more likely he is to keep on staying. This tendency is quite evident in the data on mobility of PhD's, and, without invoking the sophisticated mathematics of the formal model, one can observe the probability of a U.S. citizen going abroad after the doctorate, or of a foreign citizen staying in the United States or returning to the home country, as a function of his location at birth and at high school and college level. All of the people here concerned, of course, had United States PhD's. The same phenomenon can also be observed in the case of those foreign citizens holding postdoctoral appointments in the United States, sorted according to whether their doctorate was taken in the home country before coming here, or earned in the United States.

Of U.S. citizens with U.S. doctorates who had no predoctoral foreign contact, 86.3 percent had definite postdoctoral plans. Of those with plans, 96.6 percent planned to stay in the United States; only 3.4 percent were going abroad. Of U.S. citizens born abroad, about 5 percent planned to go abroad after the doctorate. Of those born in the United States but with secondary education abroad, 9 percent planned to go abroad after the PhD. Of those born in the United States but with foreign BA's, 18 percent planned to go abroad after the doctorate. Recency of foreign contact, or, perhaps, foreign contact actively sought rather than as an accident of birth or movement of parents, clearly relates to later plans to go abroad.

For foreign citizens with U.S. PhD's the situation is, of course, quite different. Three groups had numbers large enough for reliable statistics: Of those with all of their predoctoral education abroad, 50 percent planned to remain in the United States (omitting unknowns). Of those with U.S. baccalaureates, 73 percent planned to remain in the United States. Of those with both high school and undergraduate education in the United States, 83 percent planned to stay here after the PhD.

The results varied greatly for the postdoctoral appointees who were asked what their plans were after the termination of their present appointments,[1] depending on whether the PhD had been earned in the United States or abroad. Of those who came here after the PhD for postdoctoral training, 88 percent had definite plans, and of this group, 84

[1]Office of Scientific Personnel, NAS-NRC, *The Invisible University: Postdoctoral Education in the United States* (Washington, D.C.: National Academy of Sciences, 1969).

percent were returning to the home country, 4 percent were going to a third country, and only 12 percent stayed in the United States. Of those with U.S. PhD's, 25 percent were uncertain as to their post-training plans—many undoubtedly wishing to stay in the United States. Of those with definite plans, only 37 percent planned to return to the home country, 4 percent planned to go to a third country, and 59 percent planned to stay in the United States—five times as large a proportion as for those with foreign doctorates. These general results tended to hold for the various fields and various regions of origin with some differences in percentages.

This general tendency is further confirmed by the positive correlations between length of move at one career stage and length of move at other stages. The data shown in Table J-1 illustrate this point and show that it is similar across all fields, although it varys somewhat by geographic region. The data tabled here are for men only and include the whole 1957–1967 period. The first column shows the correlation between length of high school-to-college move and college-to-graduate school move. The second shows the correlation between length of high school-to-college move and graduate school-to-job move. The third column shows the correlation between BA-to-PhD move length and PhD-to-Job move length. The upper portion of the graph shows the field variations in these correlations; the lower portion the regional variations.

The correlations shown in Table J-1 are all modest, but they are all positive. In a more extensive table (not given here) of state-by-state correlations, almost all were positive, and the range was about the same as shown here for the regions. The principle of cumulative inertia is thus demonstrated in these data, both by probability of movement and by length of move. It is a phenomenon worth further exploration.

TABLE J-1

Correlation Coefficients between Length-of-Move at One Career Stage and Length-of-Move at a Subsequent Career Stage, 1957–1967 Male U.S. Citizen PhD's

	Correlation Coefficients		
	HS-BA vs. BA-PhD	HS-BA vs. PhD-Job	BA-PhD vs. PhD-Job
Field of PhD			
E-M-P fields	0.17	0.08	0.30
Biosciences	0.16	0.09	0.32
Social sciences	0.19	0.10	0.31
Arts and humanities	0.17	0.08	0.30
Education	0.13	0.10	0.41
Total, all fields	**0.17**	**0.09**	**0.32**
Region of PhD			
1 New England	0.15	0.08	0.37
2 Middle Atlantic	0.18	0.09	0.34
3 East North Central	0.23	0.08	0.28
4 West North Central	0.20	0.08	0.26
5 South Atlantic	0.21	0.12	0.35
6 East South Central	0.17	0.08	0.38
7 West South Central	0.17	0.10	0.35
8 Mountain	0.07	0.01	0.23
9 Pacific	0.07	0.02	0.20
U.S. total	**0.17**	**0.09**	**0.32**

APPENDIX K Survey of Earned Doctorates 1966-1968 Questionnaire Form

SURVEY OF EARNED DOCTORATES

AWARDED IN

THE UNITED STATES

SPONSORED AND CONDUCTED BY

THE GRADUATE DEANS,
THE NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL,
THE U.S. OFFICE OF EDUCATION AND THE NATIONAL SCIENCE FOUNDATION

IN COOPERATION WITH

THE AMERICAN COUNCIL OF LEARNED SOCIETIES
AND THE SOCIAL SCIENCE RESEARCH COUNCIL

TO BE RETURNED TO
THE GRADUATE DEAN FOR
FORWARDING TO

OFFICE OF SCIENTIFIC PERSONNEL
NATIONAL RESEARCH COUNCIL
2101 CONSTITUTION AVE., N.W.
WASHINGTON 25, D.C.

SURVEY OF EARNED DOCTORATES

A. Name in *full:* (7-28) Last ..... First ..... Middle ..... (Maiden) .....

B. Permanent address through which you can always be reached: ..... Care of (if applicable) .....
..... Number ..... Street ..... City ..... Zone ..... State

C. Date of birth: (29, 30) Month, day, year ..... D. Place of birth: (31, 32) State; or country if not U.S. .....

E. (28) 12☐ Married; 11☐ Not married (including divorced, widowed)

F. 11☐ Male (30) 12☐ Female

G. (33) 0☐ U.S. Citizen
1☐ Non-U.S., permanent resident
2☐ Non-U.S., U.S. citizenship applied for
3☐ Non-U.S., other .....
(if non-U.S., specify nationality)

H. (34) Number of dependents. Use U.S. income tax definition. but do not include yourself .....

Secondary or high school last attended

I. Name and location (35,36) .....

J. Size of graduating class (37) ☐ 1-9 (0); ☐ 10-19 (1); ☐ 20-39 (2); ☐ 40-59 (3); ☐ 60-99 (4); ☐ 100-199 (5); ☐ 200-499 (6); ☐ 500 and over (7).

K. Type of school (38) ☐ Public (0) ☐ Private, denominational (1) ☐ Private, non-denominational (2).

L. Year of graduation from high school (39,40) .....

DO NOT WRITE HERE
29,30 ( ) ( )
31,32
33
34
35,36
37
38
39-40
41-44
45,47 ( )
48-49

M. List in the table below all collegiate and graduate institutions you have attended, beginning with the first and ending with the one from which you are about to receive your present doctoral degree:

Institution and its location	Dates attended (years only) From	To	Check if full time	Major field Name	Major field Number (see list)	Minor field (Name)	Degree (if any)	Month & year granted

N. List title of your doctoral dissertation (if more than one, give year of degree for each) and enter the most appropriate classification *number* and *title* selected from the accompanying separate Specialties List:

Title of dissertation(s)	Classify. using Specialties List Number	Field Name

O. Please check the box which most fully describes your employment status during the year preceding the doctorate award. (66)

0☐ Student, part-time employed. (incl. graduate assistants)
1☐ Student, not employed.
2☐ On fellowship
Full Time Empl. in:
3☐ College or university.
4☐ Elem. or secondary school, teaching.
5☐ Elem. or secondary school, non-teaching.
6☐ Other category.
7☐ Working on research grant.
8☐ Other status. (specify) .....

P. Indicate total years of professional work experience (full time or full-time equivalent). (69)

0☐ None. 2☐ 1-1.9 years. 4☐ 3-3.9 years. 6☐ 6-7.9 years. 8☐ 10-14.9 years.
1☐ Less than 1 year. 3☐ 2-2.9 years. 5☐ 4-5.9 years. 7☐ 8-9.9 years. 9☐ 15 years or more.

Q. Indicate your prospects and arrangements for your professional future (please check only one). (70)

0☐ Am seeking employment but have no specific prospects.
1☐ Am negotiating with a specific employer, or more than one.
2☐ Have signed contract or made definite commitment (other than categories below).
3☐ Returning to, or continuing in, predoctoral employment.
4☐ Military service—active duty.
5☐ Have postdoctoral fellowship, sabbatical leave, or equivalent arrangement
6☐ Other (explain): .....

R. Indicate type or class of postdoctoral employer (check only one). (71)

0☐ U.S. college or university.
1☐ U.S. elementary or secondary school
2☐ U.S. gov't—federal civilian employee.
☐ Foreign: governmental or private.
4☐ State, local, or other government within the U.S. (except educational institutions).
5☐ Non-profit organization (other than 0, 1, 2, 3, or 4).
6☐ Industry or business.
7☐ Self-employed.
8☐ None.
9☐ Other ..... (Specify)

S. Place of postdoctoral employment (state; or country if not U.S.). (72,73) .....

T. Is your postdoctoral activity primarily 0☐ Research 1☐ Teaching 2☐ Administration 3☐ Professional services 4☐ Fellowship 5☐ Other (explain) (74) .....

U. Indicate, by circling highest grade attained, the education of

		grammar school							High sch				College				Graduate	
(76) your father:	none	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	MA, MD, PhD	Postdoctoral
(75) your mother:	none	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	MA, MD, PhD	Postdoctoral

V. How many older brothers did you have? (if none, write zero) (77) ..... older sisters? (78) ..... younger brothers? (79) ..... younger sisters (80) .....

W. Enter here the name of your major adviser
..... (last name)
..... (first name, middle initial)

X. List all national professional societies of which you are a member. Write out identifying words in full:
.....

Write in any supplementary information which you believe necessary to complete or explain your answer, or your inability to answer any previous items, referring to each item by letter, on the back of this sheet.

Date prepared ..... Signature .....

DO NOT WRITE HERE
50-53
54-56
( )
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59-62
63-66
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( )
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76,76
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